DISSERTATION

A CLINICAL STUDY FOR THE ROLE OF EUSTACHIAN TUBE FUNCTION FOR SUCCESSFUL MASTOIDECTOMY AND MIDDLE EAR SURGERIES.

M.S DEGREE EXAMINATION

BRANCH IV

ENT AND HEAD & NECK SURGERY

This Dissertation is submitted to

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

In partial fulfillment of the University Regulations for the award

of

Degree of MASTER OF SURGERY (OTORHINOLARYNGOLOGY)

Thanjavur Medical College, Thanjavur

2015

CERTIFICATE

I certify that the Dissertation titled **A CLINICAL STUDY FOR THE ROLE OF EUSTACHIAN TUBE FUNCTION FOR SUCCESSFUL MASTOIDECTOMY AND MIDDLE EAR SURGERIES** submitted by Dr.P.HEMALATHA., for Degree of Master of Surgery (Otorhinolaryngology) to The Tamilnadu Dr.M.G.R. Medical University, Chennai is the result of original research work undertaken by her in the department of **ENT AND HEAD & NECK SURGERY,** Thanjavur Medical College, Thanjavur.

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DECLARATION

I hereby declare that the dissertation titled **A CLINICAL STUDY FOR THE ROLE OF EUSTACHIAN TUBE FUNCTION FOR SUCCESSFUL MASTOIDECTOMY AND MIDDLE EAR SURGERIES,** a clinical study submitted by me is a result of original work carried out by myself under the guidance of **Prof.Dr.T.Ramanathan,M.S.,D.L.O., Head of the Department Otorhinolaryngology and Head and Neck ,Thanjavur** Medical College, Thanjavur .I further declare that the result of research have not been submitted previously by myself or other persons in any conferences or journals.

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This is to certify that The Research Proposal / Project titled

A CLINICAL STUDY FOR THE ROLE OF EUSTACHIAN TUBE FUNCTION FOR SUCCESSFUL MASTOIDECTOMY AND MIDDLE EAR SURGERIES

submitted by Dr. P. HEMALATHA **of**

Dept. of OTO RHINO LARYNGOLOGY **Thanjavur Medical College, Thanjavur**

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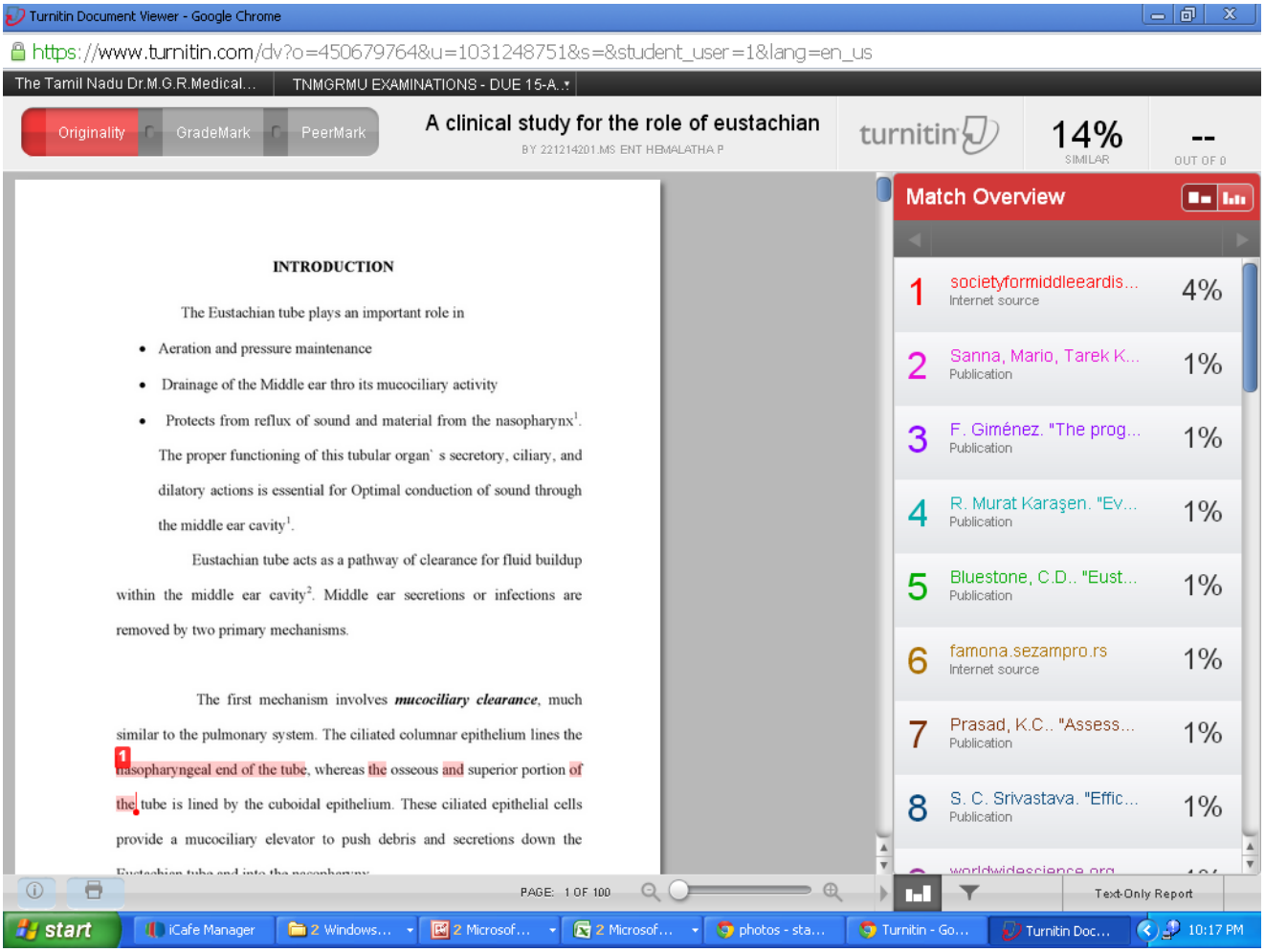
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INTRODUCTION
The Eustachian tube plays an important role in
Aeration and pressure maintenance
Drainage of the Middle ear thro its mucociliary activity
Protects from reflux of sound and material from the nasopharynx[1].
The proper functioning of this tubular organ' s secretory, ciliary, and dilatory actions is essential for Optimal conduction of sound through the middle ear cavity[1].
Eustachian tube acts as a pathway of clearance for fluid buildup within the middle ear cavity[2]. Middle ear secretions or infections are removed by two primary mechanisms.
The first mechanism involves mucociliary clearance, much similar to the pulmonary system. The ciliated columnar epithelium lines the nasopharyngeal end of the tube, whereas the osseous and superior portion of the tube is lined by the cuboidal epithelium. These ciliated epithelial cells provide a mucociliary elevator to push debris and secretions down the
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ACKNOWLEDGEMENTS

I thank The Dean, Prof ***Dr.Mahadevan M.S., and vice principal Dr.Sivagami M.S.,*** Thanjavur Medical College for permitting me to use the clinical material of this hospital for my study.

I express my deepest gratitude and heartfelt thanks to my mentor and guide ***Dr.T.Ramanathan,M.S.,D.L.O., The Professor and Head of the Department, Department of Otorhinolaryngology and Head and Neck Surgery, TMC, Thanjavur*** for his invaluable guidance, support and for his constant encouragement and inspiring views on this study. I consider it as discrete privilege to have had him as my guide. I shall always remain indebted to him.

My sincere thanks to ***Professor Dr.A.Ravindran M.S.,D.L.O., Department of Otorhinolaryngology and Head and Neck Surgery, TMC, Thanjavur*** for his invaluable advice and blessings and for the inspiration he has been to me.

I am grateful to ***Dr. K. Ramesh Babu,M.S(ENT) Senior Assistant Professor***, ***Department of Otorhinolaryngology and Head and Neck Surgery, TMC, Thanjavur*** for his constant support and blessings.

I am grateful to ***Dr.B.Ganesh kumar., M.S.,D.L.O., Senior Assistant Professor, Department of Otorhinolaryngology and Head and Neck Surgery, TMC, Thanjavur*** for his support and willingness to help all the times.

I thank ***Dr Amirthagani., M.S, (ENT)*** and ***Dr. PrincePeterDoss., M.S, (ENT) , Assistant Professors, Department of Otorhinolaryngology and Head &Neck Surgery*** for their strong motivation in my studies.

My gratitude goes to all of my colleagues and friends for their constant support and valuable help.

I would always be grateful and thankful to all the patients who took part in this study, without whom this effort would never have seen the light of the day.

I thank the almighty, my family and all the well wishers for guiding me in the right path all my life.

Dr. P.Hemalatha

A

CLINICAL STUDY

FOR

THE ROLE OF
EUSTACHIAN TUBE FUNCTION

FOR SUCCESSFUL MASTOIDECTOMY

AND

MIDDLE EAR SURGERIES

CONTENTS

INTRODUCTION

The Eustachian tube plays an important role in

- Aeration and pressure maintenance
- Drainage of the Middle ear thro its mucociliary activity
- Protects from reflux of sound and material from the nasopharynx[1].

The proper functions of the tube like secretory, ciliary, and dilatory actions are essential for optimal conduction of sound through the middle ear cavity[1].

Eustachian tube acts as a pathway of clearance for fluid buildup within the middle ear cavity[2]. Middle ear secretions or infections are removed by two primary mechanisms..

The first mechanism involves ***mucociliary clearance***, much similar to the pulmonary system. The ciliated columnar epithelium lines the nasopharyngeal end of the tube, whereas the osseous and superior portion of the tube is lined by the cuboidal epithelium.

These ciliated epithelial cells provide a mucociliary elevator to push debris and secretions down the Eustachian tube and into the nasopharynx.

The second mechanism of clearance involves ***muscular pumping***. Muscular pumping of the pharyngotympanic tube occurs as the tubal valve progressively closes from the isthmus toward the nasopharyngeal orifice, when the tensor veli palatini muscle relaxes.

Both the mechanisms work simultaneously to clear out the secretions and infections from the tympanic cavity to nasopharynx where they can be swallowed or expectorated.

The third role of 'Eustachian tube' is to prevent the ***secretions to enter the middle ear due to gastro esophageal reflux.*** It blocks the passage of sound to enter into the middle ear during speech. As the tube remains closed for all, the primary mechanism for prevention of reflux of fluid and sound is mechanical blockage due to closed lumen due to torus tubarius and Ostmann`s pad of fat. During the brief periods of time when the tube is open, reflux of sound and fluid is limited by a back pressure of air within the middle ear space so called the ***gas cushion effect***.[2]

When there is tubal dysfunction, middle ear pressure becomes negative, resulting in the aural fullness and hard of hearing. This always leads to the other sequelae such as

1. Retraction pockets and cholesteatoma.
2. Atelectasis.

3. Serous otitis media.
4. Tympanic membrane perforation.

Most of the time, middle ear infection is initiated by the viral infection which damages the ciliated mucosa of the upper respiratory tract, pharyngotympanic tube and adjacent part of tympanic cavity and permits pathogens to invade the middle ear space thro the retrograde movement from the nasopharynx.[2]. These pathogens elicit potent inflammatory responses from the middle ear mucosa. Improper ventilation can also result in the development of effusions according to ***hydrops ex vacuo theory***.[2]

Eventhough the knowledge about the Eustachian tube function is clear to everybody, its preoperative functions have not been assessed in many of the patients posted for the mastoid and middle ear cleft surgeries. Hence in our study we are emphasizing the Eustachian tube function for the successful mastoid and middle ear cleft surgeries.

In our study the function of the Eustachian tube was studied by various *methods such as the* ***siegulization, saccharin test, Valsalva test, methylene blue dye test*** and also by the ***Impedance Audiometry***.

The patients are classified into the following groups, depending upon the tubal function,

- Normal tubal function.
- Impaired tubal function.
- Absent tubal function.

All the patients underwent treatment preoperatively to restore normal function of the tube.

The ***final outcome*** of the surgery was compared with the criteria of

- Success of the graft uptake.
- Post operative dry ear.

AIMS AND OBJECTIVES

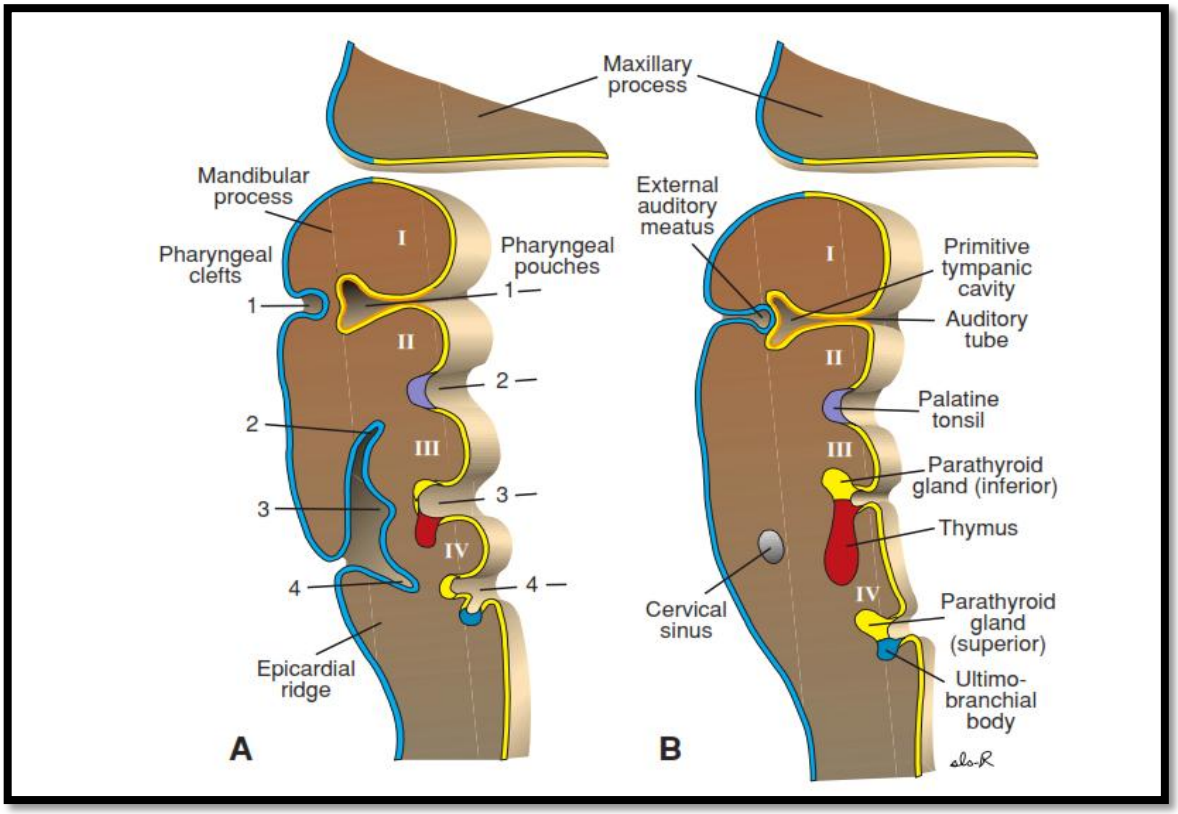
1. To study the ventilatory and mucociliary function of Eustachian tube in all the patients of chronic suppurative otitis media who are all planned for the surgery.
2. To study about the success rate of the tympanoplasty in relation to the Eustachian tube function.

ANATOMY

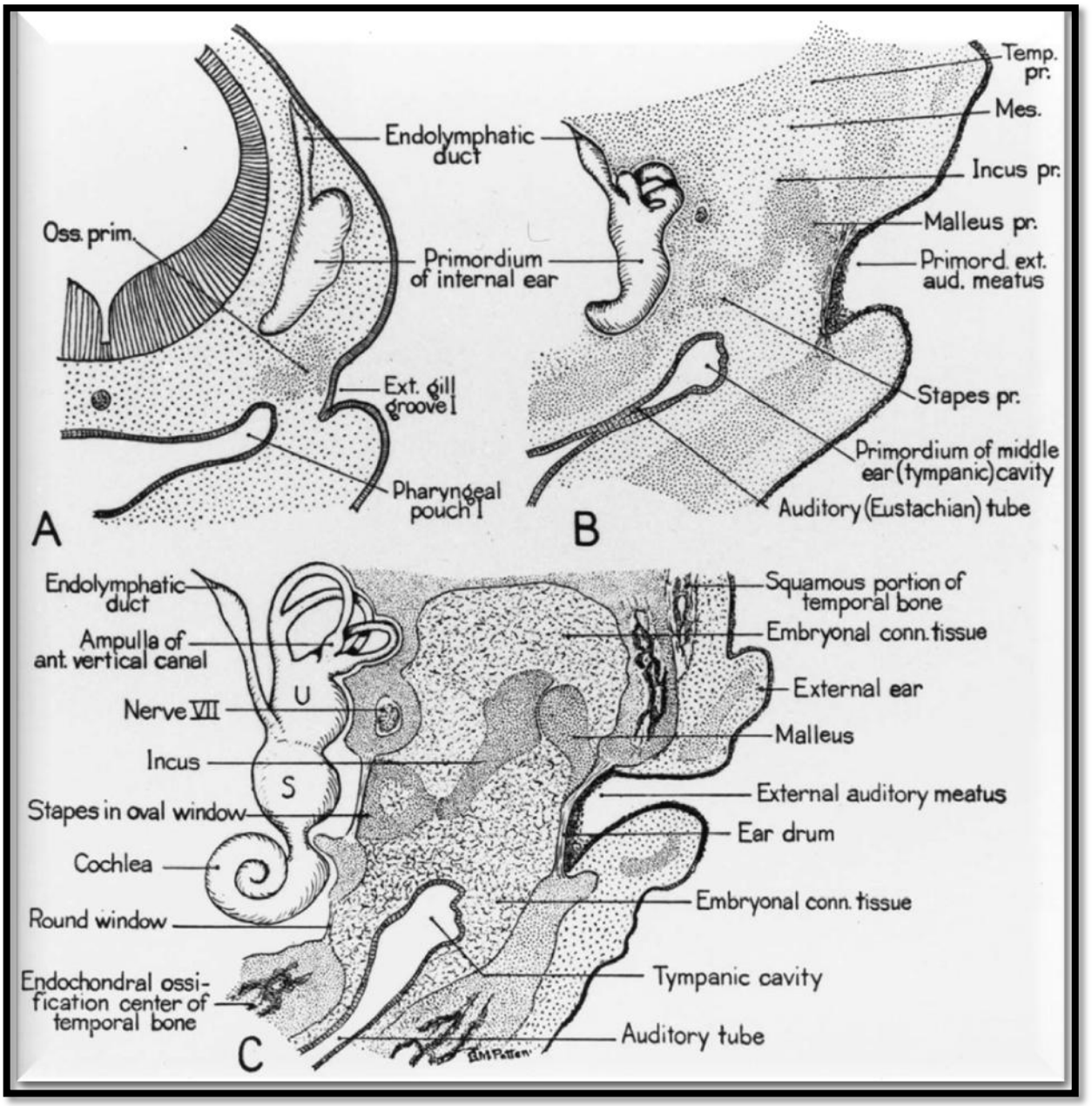
EMBRYOLOGY

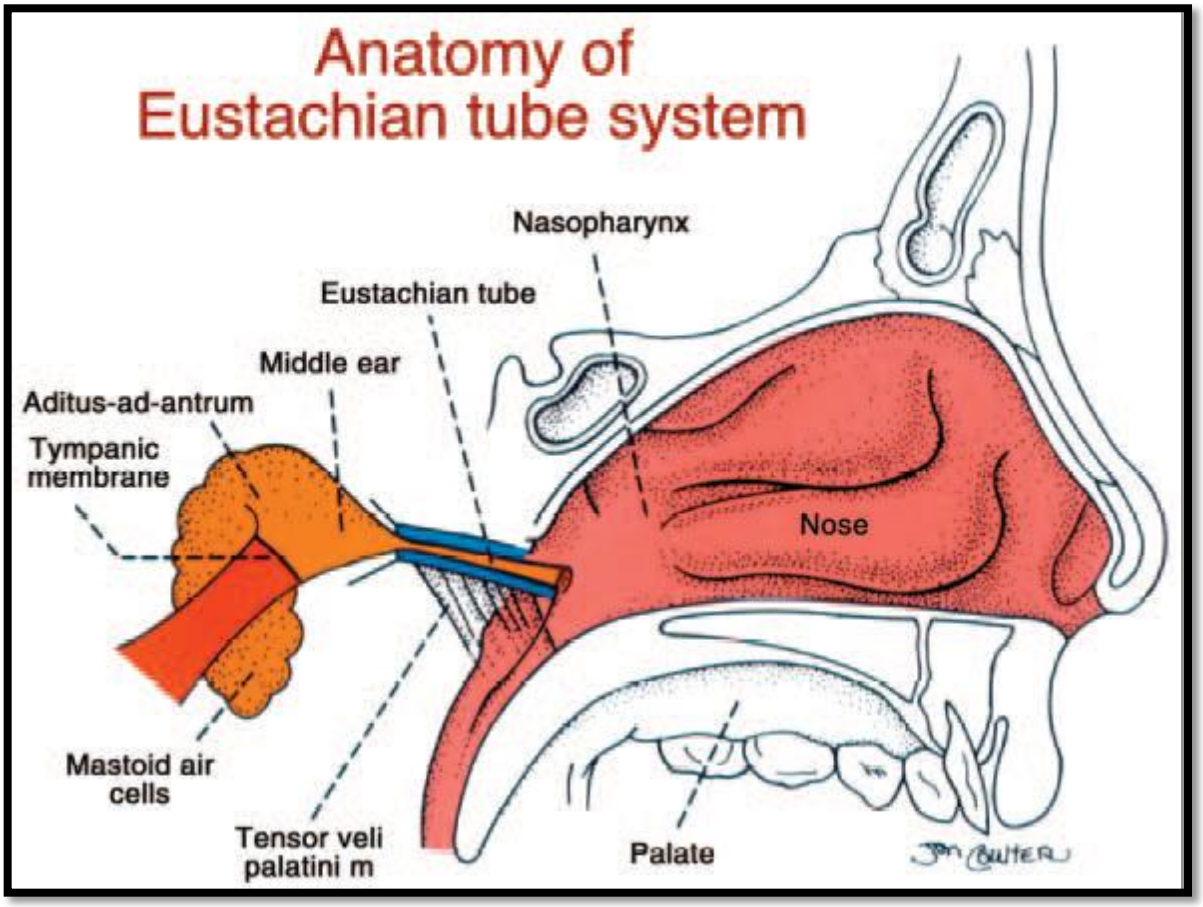
Tympanic cavity develops from the endoderm of first pharyngeal pouch.

The distal part of the pouch called as tubotympanic recesss which widens distally giving rise to the primitive tympanic cavity and the proximal part forms the auditory tube, through which the nasopharynx is connected[3].



DEVELOPMENT OF MIDDLE AND INNER EAR




Anatomy of
Eustachian tube system
Nasopharynx
Eustachian tube
Middle ear
Aditus-ad-antrum
Tympanic membrane
Nose
Mastoid air cells
Tensor veli palatini m
Palate

ANATOMY:

The Eustachian tube courses proximally from the middle ear cavity to the nasopharynx distally. This tube has two parts the proximal part and the distal part. The proximal part is bony and the distal part is cartilaginous in nature. The osseous part forms about one third of the length, funnel shaped with the wide end of the funnel extending from the anterior wall of the middle ear cavity[2].

The bony portion is about ***12 mm*** in length. The osseous portion of the Eustachian tube is also called as '***protympanic', 'aural', 'bony' or 'middle ear portion***'. This part remains patent always and this bony part of the tube lies within the petrous portion of the temporal bone which is continuous with the upper part of anterior wall of the of the middle ear.

The bony part courses anteromedially and follows the petrous apex and finally deviates from the horizontal plane slightly. The lumen is roughly triangular in shape which measures 2 to 3mm vertically and 3 to 4 mm horizontally[4]

.

BONY PART

The medial wall of the bony portion of the Eustachian tube consists of two parts [4]

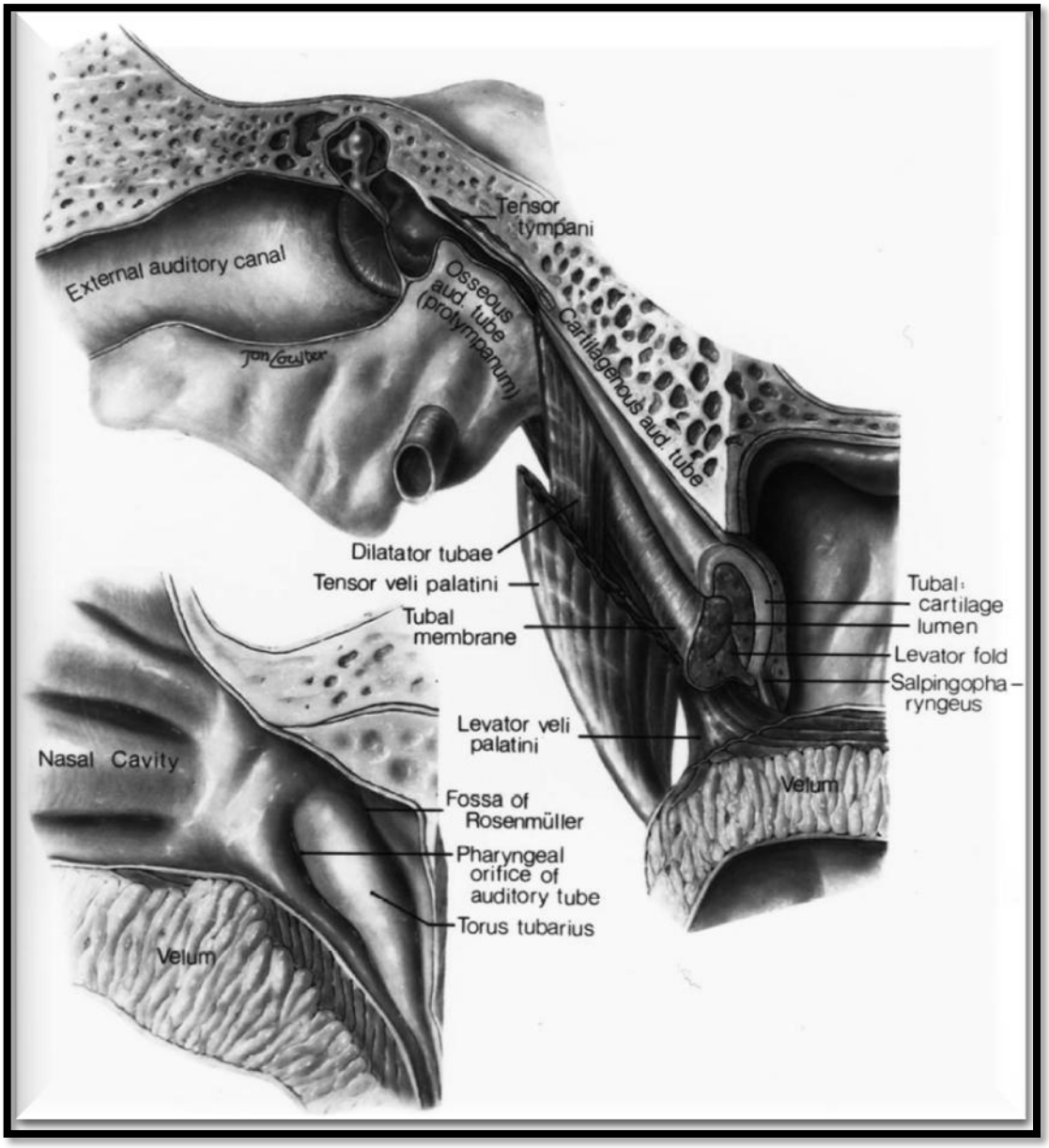
- ***labyrinthine part*** remains posterolaterally.
- ***carotid part*** remains anteromedially.

The bony part size, shape and relations depends upon the position of the internal carotid artery. Thus the average thickness of the bony part is ***1.5mm to 3mm***, if the anteromedial portion was near by the carotid artery. It is absent in about 2% of cases, exposing the carotid artery.

The aural orifice measures about 5mm x 2mm and appears as an oval structure which lies above the floor of the middle ear space. The carotid canal and the labyrinth lies beneath the medial wall of the osseous portion of the tube. [5]

This narrow end of the funnel is called as the ***isthmus*** and it is the narrowest part of the Eustachian tube which was located just proximal to the junction of bony and cartilaginous part. The bony part remains patent always.[2]

COMPLETE DISSECTION OF THE EUSTACHIAN TUBE & MIDDLE EAR



CARTILAGENOUS PART

The cartilaginous part about 24 mm in length forms the distal two thirds of the tube, courses from the isthmus into the nasopharynx and it comprises of a single segment of cartilage attached along the superior edge of the basisphenoid bone. The cartilaginous part closer to the osseous tube segment remains fixed in its position. The distal end of the cartilaginous portion which enters the nasopharynx has ***Dynamic Movement***[6]**.**

The distal end of this cartilage protrudes into the nasopharynx is termed as ***medial cartilaginous lamina*** and this medial cartilage lamina is mobile and allows the orifice to open as it medially rotates during the tubal dilatation. The medial cartilaginous lamina provides the framework for the ***torus tubarius*** which is a mobile structure also called as the ***posterior cushion***[7].

The ***lateral cartilaginous lamina***, an immobile structure also called as the ***hook or "j" portion***. The rest of the tubal orifice is completed by the fibrous membrane and it is firmly attached to the basisphenoid bone.

The ***fossa of the rosenmuller*** lies just posterior to the medial cartilaginous lamina and it is an important space containing the lymphoid tissue and it is medial to the internal carotid artery. The adenoid pad of lymphoid tissue lies medial to the fossa of Rosenmuller and thereby it

occupies the midline of the nasopharynx[8]. The paediatric Eustachian tube has many differences from the adult[9]. The paediatric tube is

- Smaller and horizontal.
- Bony part is absent.
- Shorter and wider.

OSTMANN PAD OF FAT:

The inferolateral aspect of the tube contains a pad of fat called as ***Ostmann`s pad of fat*** which prevents the tubal lumen from the abnormal increase in dilation. The excess Ostmann fat in the children than in the adults, may be the reason for the ineffective opening of the tube.[4]

MUCOSAL FOLDS:

These mucosal folds are numerous in the ***inferior portion*** of the Eustachian tube and it increases the surface area of the tube. These folds are absent in the superior portion of the lumen.[4]

The significant differences between the adult and the paediatric Eustachian tube are as follows [10] [11][12][13]

Anatomic features	***INFANT***	***ADULTS***
Length	13-18 mm	36mm(31-38)
Angle of the tube	10 deg with horizontal	45 deg with horizontal
Angle of TVPM to cartilage	Variable	Stable
Angulations' at the isthmus	No angulations	Angulations present
Bony : cartilaginous part	Longer than 1/3 of tube and relatively wider	Bony 1/3 :cartilaginous 2/3
Tubal cartilage	Flaccid	Comparatively rigid
Elastin at the hinge	Less dense	More dense
Ostmann pad of fat	Less in volume	Large
Cartilage cell density	Greater	Less
Cartilage volume	Less	Large


Infant
Adult
Eustachian tube

MUCOUS MEMBRANE OF THE TUBAL LUMEN:

The Eustachian tube is lined with the ***pseudo stratified ciliated columnar epithelium*** which pushes the material from the middle ear into the nasopharynx. 20% of the cell population was formed by the ***goblet cells***, found among the ciliated epithelial cells. The increase in these goblet cell population from 30000 to 60000 in the lateral, medial, floor, roof of the lumen accounts for the middle ear clearance function in the symptom free infants whereas in the premature infants the cell count was found to be in lower densities[15].

In ***cartilaginous portion*** of the tube,

- ***Superior part*** - performs ventilatory function.
- ***Inferior part*** – performs drainage function.

Matsunne et all identified the mucosa associated lymphoid tissue (***MALT***) inside the cartilaginous portion of the tube in the cadaver bone which has not associated with the middle ear diseases. These lymphoid follicles develop by extravasations of lymphocytes from the post capillary high endothelial venule into mucosal inflammatory sites. These are more in the bony part and in the middle ear cavity during the episodes of middle ear infections[15].

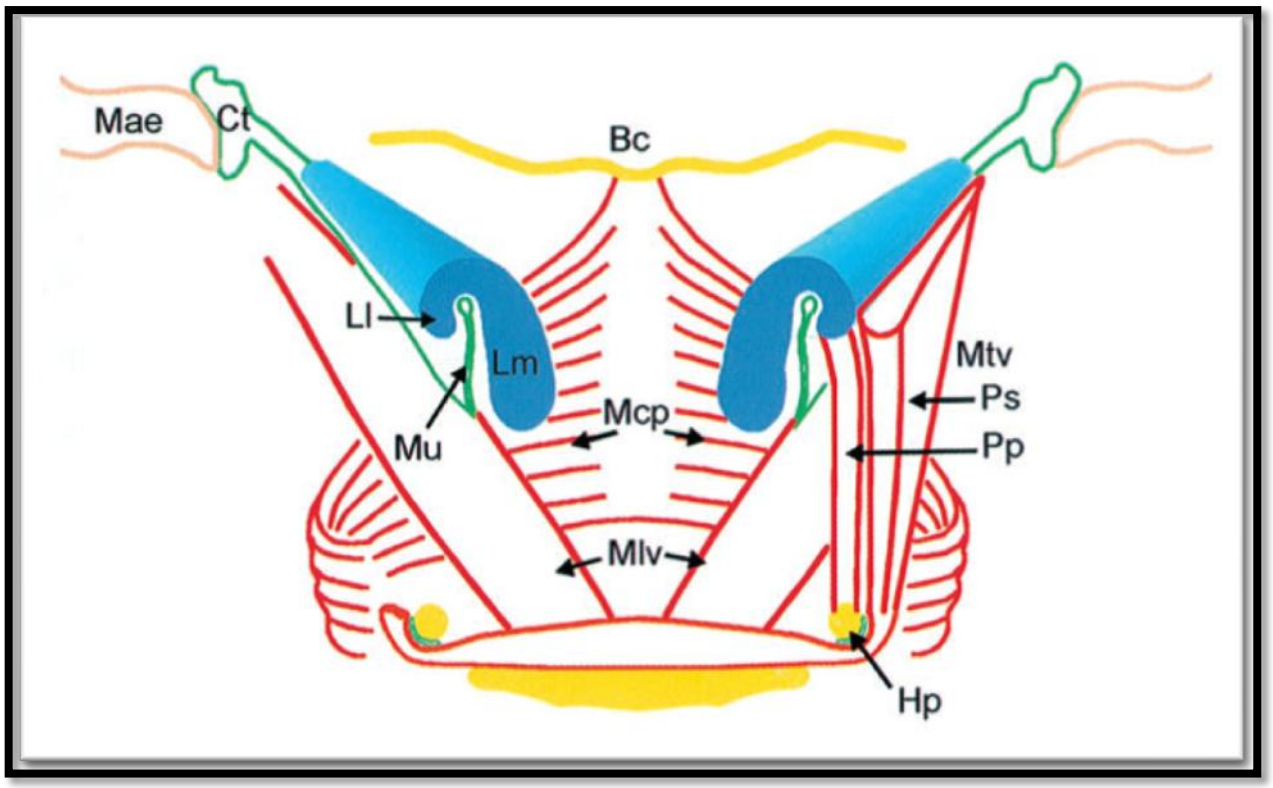
MUSCLES OF THE EUSTACHIAN TUBE:

The muscles associated with the Eustachian tube are

- Tensor veli palatini
- Tensor tympani
- Levator veli palatini
- Salphingopharyngeus

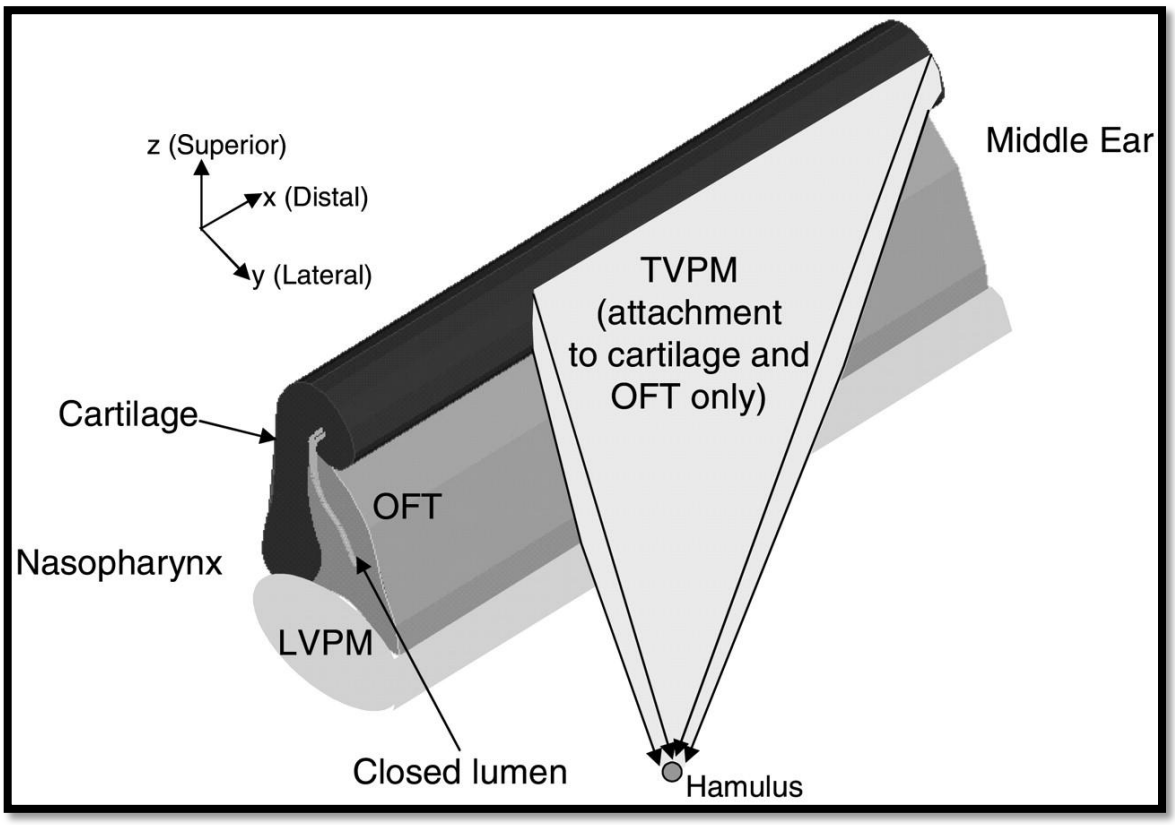
Eustachian tube is closed during the rest and it opens only during the act of yawning, sneezing, swallowing, and permitting to equalize the middle ear pressure with that of the atmospheric pressure.

The tube was actively opened by the tensor veli palatini alone or with the help of Levator veli palatini. The tubal closure was achieved by the passive reapproximation of the tubal walls by the extrinsic forces and also by the recoil of elastic fibers' within the tubal cartilage or by both the mechanisms[15].



Schematic representation of both Eustachian tubes, viewed from the anterior Aspect[16]. Bc = skull base, Mae = external auditory canal, Ct = tympanic cavity, Ll = lateral lamina of tubal cartilage, Lm = medial lamina of tubal cartilage, Mu = mucosa, Mcp = constrictor pharyngis superior muscle, Mlv = levator veli palatini muscle, Mtv = tensor veli palatini muscle with superficial part (Ps) and deep part (Pp), Hp = pterygoid hamulus

TENSOR VELI PALATINI MUSCLE:



The tensor veli palatini muscle is composed of two distinct bundles of muscle fibers, (divided by a layer of fibro elastic tissue).

- Tensor veli palatini
- Dilator tubae.

Tensor veli palatini forms the more lateral bundle, forms a shape of inverted triangle. Its origin is from the scaphoid fossa and also from the

greater wing of sphenoid. The force the muscle exerts on this origin creates the lateral osseous ridge of the sulcus tubarius.

The muscle descends anteriorly; laterally and inferiorly to converge in a tendon that rounds the hamular process of the medial pterygoid lamina about an interposed bursa. These fibers group then inserts into the posterior border of the horizontal process of the palatine bone and into the palatine aponeurosis of the anterior portion of the velum.

Dilator tubae is the medial bundle of the tensor veli palatini muscle and lies immediately adjacent to the lateral membranous wall of the tube and this was first described by the ***Valsalva*** and subsequently confirmed by the anatomical dissections. Its superior origin is in the posterior half of the lateral membranous wall of the cartilaginous tube.

These fibers descend sharply to enter and blend with the fibers of the lateral bundle of the tensor veli palatini. The inner bundle is responsible for the active dilatation of the tube. Thus this angular relationship between the tensor veli palatini muscle and the cartilage varies in the infants but it is relatively stable in adults.

The dilator tubae of tensor veli palatini muscle inserts into the cartilaginous portion of the Eustachian tube which is responsible for the

dilatation, to equilibrate the middle ear pressure during the act of swallowing[15].

TENSOR TYMPANI:

The tensor tympani muscle arises from the

- Posterior fibers from the top of the ***cartilaginous*** part of the tube.
- From the adjacent portions of the ***greater wing of the sphenoid*** near the carotid canal.
- From the wall of the osseous canal through which the muscle passes

  It is about ***2 cm*** in length. The rounded tendon of this bipennate muscle leaves the canal at the cochleariform process and extends in a direction almost at right angles to the belly of the muscle across the tympanic cavity and it is inserted on to the ***inner margin of the handle of malleus*** just below its short process [15].

SALPHINGOPHARYNGEUS:

The salphingopharyngeus muscle arises from the medial and inferior borders of the cartilage via muscular and tendinous fibers. This salphingopharyngeus muscle blends with the palatopharyngeus by coursing in Posteroinferior direction.

This muscle helps to open the tube during the swallowing. The muscle is represented by a ridge on the lateral wall of the nasopharynx in the resting stage but during contraction, this muscle fold stands out and narrows the nasopharynx [15].

CILIARY TRACT:

The main features of the ciliary pattern are as follows

1. The ciliary lining of the tube is continued over the medial wall, lateral wall, roof (the superior tract), floor of the part of the tympanic cavity [15].
2. The hypotympanum (the inferior tract) is covered with the ciliated epithelium [15].
3. The drum is devoid of cilia [15].

4. The posterior part of the tympanic cavity behind the drum is covered by the epithelium of the superior tract or inferior tract by extension [15].

5. The Posterosuperior part of the promontory, the posterior attic and the aditus comprise a largely non functional area from the ciliary activity standpoint of view [15].

6. The antrum and the mastoid cavities contain no cilia in the normal ear[15]

INNERVATION OF THE TUBE:

- The pharyngeal orifice of the tube is supplied by the branches from the ***otic ganglion***, the ***sphenopalatine*** and the ***pharyngeal plexus*** [15].
- The rest of the tube receives its sensory supply from the tympanic and pharyngeal plexuses [15].
- The glossopharyngeal nerve plays an important role in the innervations of the tube [15].
- Sympathetic innervations is from the paired glossopharyngeal nerves, sphenopalatine ganglion, otic ganglion, the Petrosal nerves and the caroticotympanic nerves [15].

- The parasympathetic nerve supply is from the tympanic branch of glossopharyngeal nerve (according to Mitchell) [15].
- The ventromedial part of the ipsilateral trigeminal motor nucleus through the trigeminal nerve supplies the tensor veli palatini and tensor tympani muscles [15].
- The nucleus ambiguous thro the vagus nerve supplies the Levator veli palatini muscle [15].

BLOOD SUPPLY OF THE EUSTACHIAN TUBE:

1. Ascending pharyngeal artery
2. Pharyngeal branch of the internal maxillary artery
3. Artery of the pterygoid canal
4. Ascending palatine artery
5. Middle meningeal artery

LYMPHATICS OF THE EUSTACHIAN TUBE:

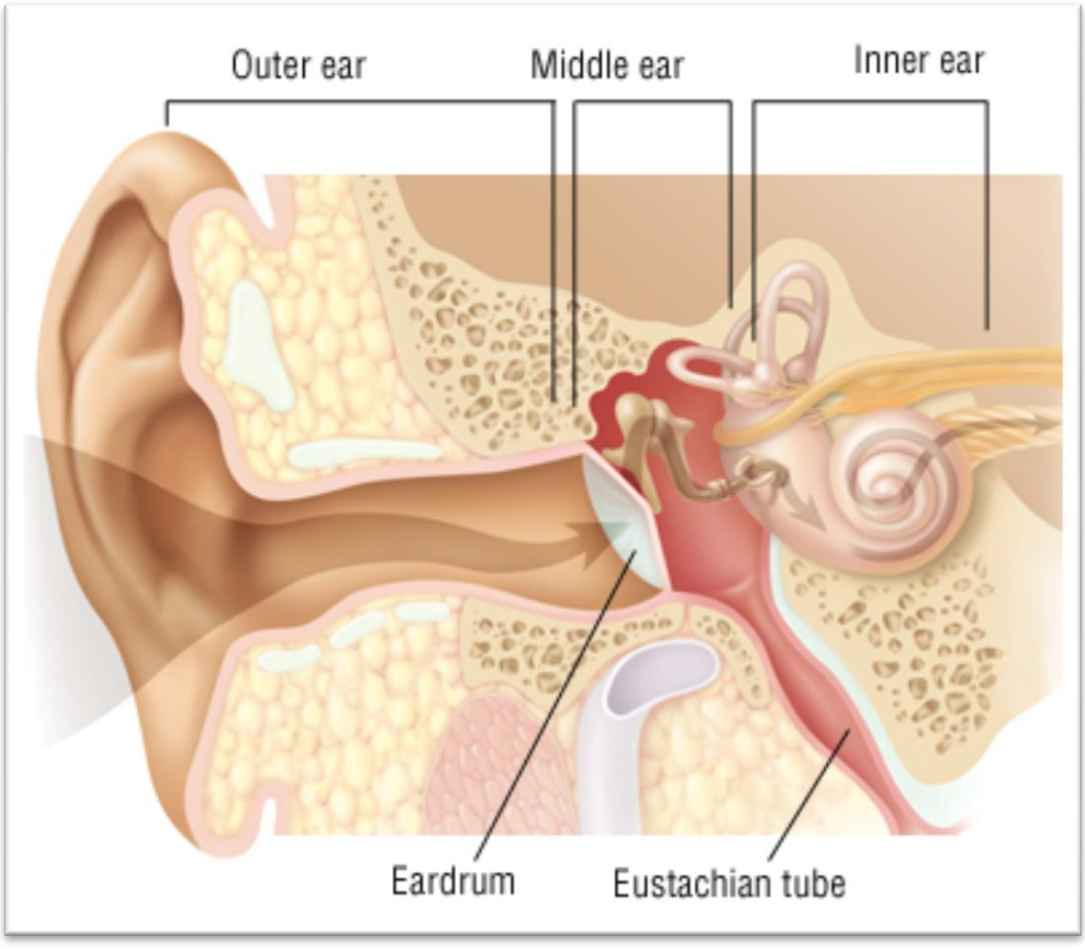
- An extensive network is in the tunica propria of the submucosa of the Eustachian tube.
- It is abundant in the cartilaginous portion of the tube than in the osseous portion of the tube.

And it finally drains either medially into the retropharyngeal nodes or laterally into the deep cervical nodes [15].

MIDDLE EAR CLEFT:

It consists of the following

- tympanic cavity
- Eustachian tube
- Mastoid air cell system.



The tympanic cavity is an irregular, air-filled space within the temporal bone which lies between the tympanic membrane laterally and the osseous

labyrinth medially. It contains the auditory Ossicles, muscles, nerves and windows.

The Tympanic Membrane:

The tympanic membrane is conical shape and it is placed anteroinferior in direction. This tilt causes anterior inferior part of the external auditory canal to be longer than the posterior superior part. The anterior part of the tympanic membrane is difficult to visualize because of this angulation[17].

The ear drum is made up of three layers, the outer squamous , the middle fibrous and the inner mucosal layer. The ear drum is classified into attic region or the parsflaccida and the vibratory region or the parstensa. The outer border of the parstensa becomes rounded to form ***annulus tympanicum*** which snugly fits into the bony groove called ***tympanic sulcus***. The attic lies above the lateral process of the malleus[17].

THE OSSICLES

MALLEUS:

The handle of the malleus was firmly attached to the ear drum. The tip of the malleus forms the ‘’umbo’’, remains conical in shape. The malleus

head is present in the attic region which articulates with the body of the incus.

The tensor tympani is attached to the neck of the malleus prevents the excessive sound to pass in to the middle ear during the acoustic trauma. The malleus head had been stabilized in its position by the suspensory ligaments of anterior and posterior [17].

INCUS:

The incus has a body, long process and short process. The body articulates with the head of the malleus. The short process, which projects posteriorly, lodges in fossa incudis. The long process projects into mesotympanum and lenticular process articulates with the stapes. This ossicle is held in its position anteriorly by the malleus and posteriorly by the posterior incudal ligament [17].

STAPES:

This is the smallest of the three Ossicles and in fact the smallest one in the entire human body. It has the head, neck, anterior crus, and posterior crus, foot plate. The head articulates with the incus at the incudostapedial joint.

The stapedius muscle attached to the head and posterior crus. The oval window is covered by the foot plate. The vestibule lies beneath the oval window. The annular ligament is a connective tissue which attaches the foot plate to the margins of the oval window. When the stapedius muscle contracts causing movement of the foot plate, annular ligament limits sound transmission into the inner ear [17].

MIDDLE EAR CAVITY:

The middle ear cavity[17] is divided into

- Attic or Epitympanic region
- Mesotympanic region
- Hypotympanic region
- Protympanic region

The attic region

It is situated above the malleolar folds. It contains the head of the malleus, body and short process of the incus. The attic is connected to the antrum by the aditus.

The mesotympanic region

It lies medial to the pars tensa of the tympanic membrane.

The hypotympanic region

It lies below the level of tympanic membrane.

The Protympanic region:

The region is adjacent to the tympanic end of the Eustachian tube orifice.

***The Medial Wall*:**

Processes cochleariformis:

The tensor tympani tendon hooks around this process, lies medial to the neck of the malleus, inferior to the horizontal part of the facial nerve and remains just anterior & superior to the oval window. This tendon takes an angle of 90 degree and finally attaches to the malleus neck.

Promontory:

This is prominent eminence remains anterior and inferior to the oval window and anterior to the round window. It represents the cochlear basal turn.

Oval window:

The oval window transmits the sound energy to the scala vestibuli, during the vibration of the foot plate of the stapes. The horizontal segment

of the facial nerve runs superior to the oval window. From there the nerve turns further in inferior direction towards the stylomastoid foramen.

Round window:

The round window niche present below the oval window, is closed by the secondary tympanic membrane. This window covers the cochlear fluid which is present in the bony canal. The round window membrane can be seen only after removing the bony overhang present in the niche.

The Posterior Wall

The posterior wall of middle ear contains the deep recesses. The vertical portion of facial nerve running through this wall has the following relations,

Medial – tympanic sinus

Lateral – facial recess

Facial recess:

Boundaries:

Laterally – tympanic annulus

Medially – fallopian canal

Superior – incus buttress

It is an important surgical landmark for posterior tympanotomy approach during intact canal wall tympanoplasty. The chordal crest is bridge of bone that divides the facial recess into four sinuses

- Facial sinus
- Lateral tympanic sinus
- Posterior tympanic sinus
- Sinus tympani

The Attic

The attic lies above the malleolar folds. It is divided into medial and lateral attic. The space lateral to the Ossicles is called lateral attic. Space medial to the ossicle is medial attic. This medial attic is divided into anterior and posterior attic by cog.

The cog

Cog is a vertical bony projection, points just anterior to the malleus head. It divides the medial epitympanum into anterior and posterior parts. The anterior one is called supratubal recess. Cog is a surgical landmark of the facial nerve. Posterior to the epitympanum lies aditus ad antrum through which mastoid antrum communicates with the middle ear.

Antrum

The largest and the most constant mastoid air cell.

Relations

Anterior – attic

Superior – middle cranial fossa

Medially – labyrinth (Lateral semicircular canal).

Labyrinth

Semicircular canals

The three semicircular canals are at right angles to each other forming ***solid angle***. The lateral semicircular canal is directed from antero superior to Posteroinferior sloping around thirty degrees. The posterior one lies just behind the lateral one and parallel to the dura of posterior cranial fossa. The superior semicircular canal lies just below the middle cranial fossa. Each semicircular canal has an ampullated and non ampullated ends.

The non ampullated ends of posterior and superior canals join to form the ***crus commune***. The ampulla of posterior semicircular canal lies just medial to the vertical segment of the facial nerve. The ampullae of these lateral and superior semicircular canals are seen in medial wall of posterior epitympanum.

The vestibule:

It is the central chamber of the labyrinth lying medial to oval window. It contains utricle (within the elliptical recess) and saccule (within spherical recess)

Relations

Anterior – cochlea

Posterior – semicircular canals

Lateral – oval window

Medial – fundus of internal auditory canal

The ductus reunions connect scala vestibuli of cochlea and vestibule. .

The Cochlea:

The cochlea is a coiled tube forms 2 – 2.5 turns around a pyramidal bone in the central region called as the ***modiolus***. The modiolus transmits the vessels and nerves to the cochlea lies directed to the internal acoustic meatus.

The osseous spiral lamina presenting around the modiolus is similar to the thread of a screw. This divides the bony cochlea partially and gives attachment to the basilar membrane. The three compartments in the bony cochlea are

- Scala media
- Scala vestibuli
- Scala tympani

The content of the scala vestibuli and the scala tympani is the perilymph which communicates with each other by an opening called the helicotrema. The footplate of stapes closes the scala vestibuli there by it separates the middle ear (air filled) from the perilymph.

The scala tympani is connected with the sub arachnoid space by the cochlear aqueduct and this scala tympani is closed by the secondary tympanic membrane.

Internal Acoustic meatus:

The internal acoustic meatus is about 1 cm in length. It directed laterally from the CP angle via the petrous bone. This IAM can be seen in the petrous bone posteriorly. The entire length of the canal is lined by dura which is an extension from the posterior cranial fossa.

This Dural sheath blends with the nerves in the canal at their corresponding foramina. The fundus of the canal lies at its lateral end. It is closed by a plate of bone which is divided into upper and lower zone by a horizontal crest.

The ***Bill's bar*** divides the upper zone into anterior (for Facial nerve) and posterior (for Superior vestibular nerve) parts. Cochlear nerve is seen anteriorly in the lower zone and posterior to it runs inferior vestibular nerve. Singular nerve runs Posteroinferior to inferior vestibular nerve.

Vessels passing through internal auditory canal:

- Internal auditory artery
- Internal auditory vein
- Anterior inferior cerebellar artery

Carotid Artery:

This artery runs upwards in carotid foramen. After emerging out of this foramen it turns and runs towards petrous apex posteroinferior to Eustachian tube and anterior to cochlea.

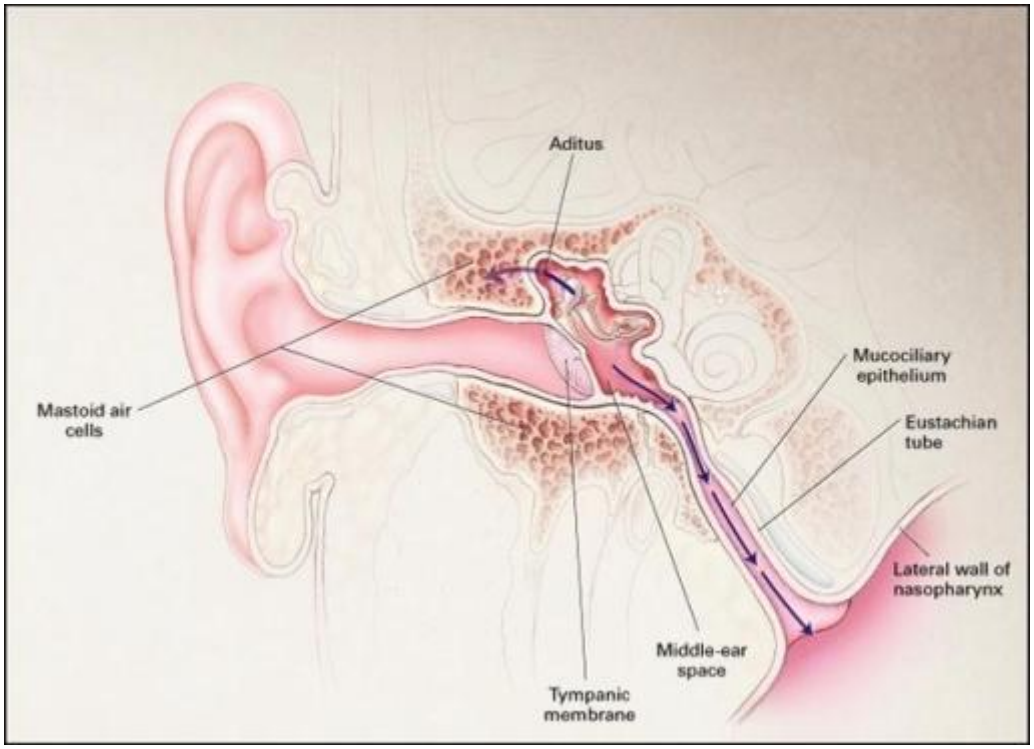
Sigmoid sinus and Jugular Bulb:

The transverse sinus continues as the sigmoid sinus which is present between the two layers of dura. Superior petrosal sinus drains into upper part of sigmoid sinus.

The jugular bulb is formed by continuation of distal end of sigmoid sinus which further continues as internal jugular vein. It is present posteriorly in the jugular foramen. The vertical portion of facial nerve is located lateral to it.

The semicircular canals are present superior to it. Due to the variable position of the jugular bulb, the distance between the bulb and labyrinth is variable [17].

PHYSIOLOGY OF EUSTACHIAN TUBE



The Eustachian tube performs three important physiological functions. They are

1. Pressure regulation (ventilation)
2. Protection of the middle ear from the nasopharyngeal sound pressure & secretions.
3. Clearance of secretions produced within the middle ear from the nasopharynx.

PRESSURE REGULATION:

The tube remains closed in all the times and it opens only transiently. This helps in blocking the ***acid reflux*** being entered into the middle ear cavity and also the abnormal perception of once own voice (***autophony***). The tensor veli palatini muscle has the significant bulk which when the muscle was relaxed serves to obliterate the Eustachian tube orifice.

The anterolateral wall of the tubal orifice contains the collection of the fat, termed ***Ostmann pad*** of fat. Thus the combination of mucosa, submucosa, Ostmann fat pad and tensor veli palatini functions as a valve within the cartilaginous lumen within the mucosal surfaces during the opposition and closure [18][19].

The brief intermittent periods of Eustachian tube dilatation must occur in the normal individuals for ventilation to occur. These periods of tubal dilatation and patency are due to the contractions of peritubal musculature.

The following muscles involved in the peritubal musculature [18][19]

1. Tensor veli palatini (most important)
2. Levator veli palatini
3. Salphingopharyngeus
4. Tensor tympani

There are ***four distinct phases*** involved in the opening of the Eustachian tube opening.

- ***FIRST PHASE:***

It involves the elevation of the soft palate along with the medial rotation of the medial cartilaginous lamina and the posteromedial wall which occurs due to contraction of the Levator veli palatini, resulting in initial dilatation of the nasopharyngeal orifice. Thus the Levator veli palatini remains contracted for all the four phases of Eustachian tubal opening. This may act as a scaffold that helps the tensor veli palatini to dilate the valve to keep in open position [7].

- ***SECOND PHASE:***

The second phase occurs as the superior pharyngeal constrictor muscles contracts which results in a medial displacement of the lateral pharyngeal wall. Thus it causes a transient narrowing of the Eustachian tube orifice [7].

- ***THIRD PHASE:***

The third phase occurs due to contraction of the tensor veli palatini which causes the Eustachian tube to dilate laterally (acting on the membranous Eustachian tubal wall)[7].

- ***FOURTH PHASE:***

The fourth or the final phase occurs when the tensor veli palatini contracts maximally producing an effacement of the anterolateral wall of the Eustachian tube orifice having maximal opening. Thus the tube has ***rounded appearance*** during the maximal dilatation. The entire four phases of opening lasts for around ***400ms*** only.

The tubal dilatation propagates from the nasopharyngeal orifice and propagates to the valve and then to the bony isthmus whereas the tubal closure results in the pumping action which clears the middle ear space from its secretions [7].

The tubal closure occurs by the ***sequential relaxation*** of the ‘‘***tensor veli palatini***’’ and the ‘***’Levator veli palatini***’’ of the tubal musculature finally returning to its final configuration with a convex bulge along its anterolateral wall [20][21].

The tube dilates during the swallowing and yawning. There are some studies that the tube has autonomic control for the intermittent, involuntary dilatations, through the baroreceptors and chemoreceptors found within the middle ear cavity [22][23][24][25].

The ***exchange of gases*** between the middle cavity and the mucosa occurs during the closure of the tube. The venous blood contains the lesser amount of dissolved nitrogen and also has a slightly lower pressure

compared to the atmospheric pressure which results in a large gradient between the overall pressure and the partial pressure of nitrogen.

Subsequently the ***nitrogen slowly diffuses into the venous blood from the middle ear***. This process leads to a steady absorption of gas from the middle ear causing an ***increased negative pressure*** within the middle ear space relative to the atmosphere.

Each gas within the middle ear cavity has different solubility constant for diffusion into the mucosa. Co_2 diffuses more readily approximately 40 times the nitrogen but the oxygen was roughly twice as soluble as nitrogen. Hence the Co2 and O_2 play a greater role in shorter term pressure effects in comparison to nitrogen. The negative pressure continues to build until the tube opens periodically. Thus ***negative pressure*** was formed within the middle ear and mastoid spaces due to the ***diffusion of gases*** into the mucosal lining and capillaries [26].

Surfactants also have been identified in the ***exchange of gases*** across the mucosal barriers and also ease in opening of the Eustachian tube orifice. These surfactants are found in the ***Eustachian tube*** and the ***middle ear cavity***. Surfactant is defined as any substance which results in a decreased surface tension and are found mostly in the lungs but also seen within the middle ear and mastoid spaces. Aeration of the middle ear space occurs during the opening [27].

At the inferior end of the tubal orifice, the air in the nasopharyngeal end found at the atmospheric pressure is exchanged with the middle ear gases allowing equalization of pressure on both sides of the tympanic membrane.

The tube opens during the swallow and yawn for a duration ***0.4-0.5 seconds*** (i.e.) 1.4 times for each minute approximately. There is a net absorption of gases between the two openings creating the negative middle ear pressure in the middle ear spaces ranging between ***0 and -50cm H_20*** in the healthy awake individuals [28].

CLEARANCE FUNCTION:

This is an another important function of the Eustachian tube, the tube serves as a pathway for the secretions building in the middle ear cavity and within the Eustachian tube by the two primary mechanisms.

- The first mechanism is the ***mucociliary clearance*** similar to the pulmonary system. For this the nasopharyngeal part or inferior part of the tube is lined by ciliated columnar epithelium and the superior part or osseous portion of the tube is lined by respiratory cuboidal type of epithelium. Thus these ***ciliated epithelium*** acts as a

Mucociliary elevator to push the debris and secretions down into the Eustachian tube and into the nasopharynx [29].

- The second mechanism of clearance is by the ***muscular pumping***. This occurs as the tubal valve closes progressively from the isthmus towards the nasopharyngeal orifice during the relaxation of the tensor veli palatini. Hence these two mechanisms work synergistically and there by propels the fluids and debris down to the Eustachian tube and out of the orifice within the nasopharynx that can be swallowed or expectorated [19].

PROTECTIVE FUNCTION:

The third important role of the Eustachian tube is to prevent the ***gastro esophageal reflux*** penetrating into the middle ear cavity and to block the passage of sound from entering the middle ear during the speech. As the tube remains closed for all the times and it opens only briefly, the ***mechanical blockage*** of the tube itself aids in protective function [18].

PATHOPHYSIOLOGY

There are various factors involved in the etio-pathogenesis of otitis media. They are infection (usually viral & bacterial), Eustachian tube dysfunction, poor immunological status, and poor socio economic &environmental factors. In paediatric ages, the immature auditory tube along with the immature immune status contributes to the main pathogenesis. Hence in such age groups the otitis media is the most common complication of the frequent URTI. Thus the factors involved in the pathogenesis of otitis media are as follows [30].

- ***INFECTION***
- ***ALLERGY***
- ***ANATOMIC AND PHYSIOLOGICAL DYSFUNCTION***
    - *I. EUSTACHIAN TUBE DYSFUNCTION*
    - *II. CLEFT /SUBMUCOUS CLEFT PALATE*
- ***ENVIRONMENTAL FACTORS***
    - *I. DAY CARE CENTER*
    - *II. SMOKING*
- ***HOST FACTORS***
    - *I. IMMATURE/IMPAIRED IMMUNE SYSTEM*
    - *II. FAMILIAL SYSTEM*
    - *III. BAD FEEDING HABITS FOR BABIES*

IV. SEX

V. RACE

The tubal dysfunction plays a major role in CSOM. This concept was first suggested by the ***politzer*** before hundred years. Most of the patients with the otitis media and the other related middle ear pathologies have abnormal tubal function such as the inflammation and infection which results from the reflux, aspiration, or insufflations of the microorganisms from the nasopharynx into the tympanic cavity through the auditory tube.

But some patients have inherent disease of mucosa as a result of allergy or in rare circumstances conditions of abnormal motility of the cilia such as kartageners syndrome[30]. Etc

The pathogenesis of the acute otitis media follows the pathogenesis of infection or allergy which results in congestion of the inflammation of the upper air tract (including the mucosa of the auditory tube and the

nasopharynx). The congestion of the mucosa in the auditory tube results in the narrowing of the isthmus of the tube, leading to the obstruction and negative pressure within the tympanic cavity and prolongation of this negative middle ear pressure along with the aspiration of the pathogen from the nasopharynx in to the tympanic cavity initiates the pathology.

Thus tubal blockage leads to the stagnation of the middle ear secretions and it leads to the proliferation of the microbial organisms within the middle ear resulting in the symptomatic otitis media.

But the prolonged negative middle pressure itself can lead to sterile middle ear effusion. The ***anatomic*** and or ***physiological dysfunction*** of the Eustachian tube dysfunction plays a key role in the pathogenesis of the acute otitis media and the otitis media with effusion. Thus the children with such an underlying deformity can have the repeated attacks of AOM or secretory otitis media [10].

The atrophy of the drum or the healed perforations with dimeric membrane poses a greater risk for the permanent perforation. According to the ***tos et all, most*** of the tympanic membrane perforations are the sequelae of secretory otitis media. The condition follows the following sequences (i.e)

- ✓ Long term poor Eustachian tube dysfunction leading to the secretory otitis media
- ✓ Atrophy of the drum with or without retraction
- ✓ Perforation of the atrophic drum
- ✓ Poor healing of the drum and leading to the atrophy.
- ✓ Finally a permanent perforation of the ear drum and the secondary infection leading to active middle ear diseases which in turn affects the Eustachian tube function.

EUSTACHAIN TUBE DYSFUNCTION:

The Eustachian tube dysfunction can be

1. Functional obstruction.
2. Mechanical obstruction.
3. Both of the above combinations.

Functional obstruction:

This can be due to persistent collapse of the Eustachian tube due to the increased tubal compliance, inefficient active opening of the tube or a combination of both. This condition was first described by the ***Bluestone*** in children with uncorrected palatal clefts having CSOM with active discharge.

The functional Eustachian tube obstruction was common in infants and younger children with cleft palate, the reason may be due to the poor cartilaginous support and relatively less number of cartilaginous cell population within the tube in the infants and the younger children, while comparing the adults [10].

Another possible reason may be due to the marked age related differences in the craniofacial base which renders the tensor veli palatini muscle to be less efficient and hence causing the functional obstruction, creating negative middle ear pressure. When this combines with the marked collapse or retraction of the ear drum called as the atelectasis.

The ventilation occurring inspite of the negative pressure causes the nasopharyngeal secretions to get sucked inside into the tympanic cavity which results in the AOM with effusion. The serous otitis media results in if the ventilation does not occurs producing a ***sterile effusion***.[10]

Mechanical obstruction:

The intrinsic or the extrinsic problem within the Eustachian tube can cause the mechanical obstruction. The intrinsic obstruction may be due to the abnormal geometry or intraluminal or mural factors that compromise the lumen of the tube. Of these the most common is the inflammation which may be due to the infection or allergy.

The acute or chronic inflammation of the mucosal lining of the tube (due to the ***polyps or cholesteatoma***) is the most common cause of obstruction of the osseous part of the tube.

The extrinsic obstruction may be due to the increased extramural pressure during supine posture or due to the ***adenoid mass*** etc. The partial tubal obstruction leads to the atelectasis of the tympanic membrane, bacterial otitis media with effusion whereas the more severe obstruction leads to the sterile OME.

In some extreme cases the tube remains open even at the rest called as the ***patulous tube*** which occurs in the conditions such as the weight loss or due to the mural or intraluminal factors resulting in the gush of nasopharyngeal secretion in to the tympanic cavity producing the "***reflux otitis media"***. Thus the patulous pharyngotympanictube sucks the secretions

of the nasopharynx into the tympanic cavity during the time of nose blowing, sneezing, crying and also during the closed nose swallowing [10].

Allergy and auditory tube function:

This is the most common cause of CSOM people living with allergy. The reason behind this in causing the otitis media remains hypothetical or controversial. The possible mechanisms may be as follows

1. Mucosa of the tympanic cavity acts as the ***shock absorber***.
2. Inflamed mucosa of the auditory tube.
3. Nasal obstruction due to inflammation.
4. Aspiration of bacterial contaminated secretions from the nasopharynx.
5. Increased circulation of inflammatory mediators in the persons with the allergy in the mucosa resulting in the increased permeability and resulting in the altered gas exchange.[10]

ASSESSMENT OF EUSTACHIAN TUBE FUNCTIONS:

There are various tests of assessing the Eustachian tube function. The classical tests which are still in use today are Valsalva`s test, Toynbee`s test and politzer test and nasopharyngeal tube catheterization [31] etc.

Valsalva test:

This test qualitatively evaluates the effect of high positive nasopharyngeal pressure upon the Eustachian tube. The test was taken to be positive when the auditory tube and tympanic cavity can be inflated by a forced expiration against the closed glottis and both the nostrils closed.

***Toynbee test*:**

This test is performed by instructing the subject to deglutinate with the nostrils and closed lips or compressed. This process generally produces a positive pressure within the nasopharynx followed by a phase of negative pressure. This negative pressure within the tympanic cavity after the Toynbee test or only transient negative tympanic cavity pressure followed by ambient pressure usually indicates good tubal function.

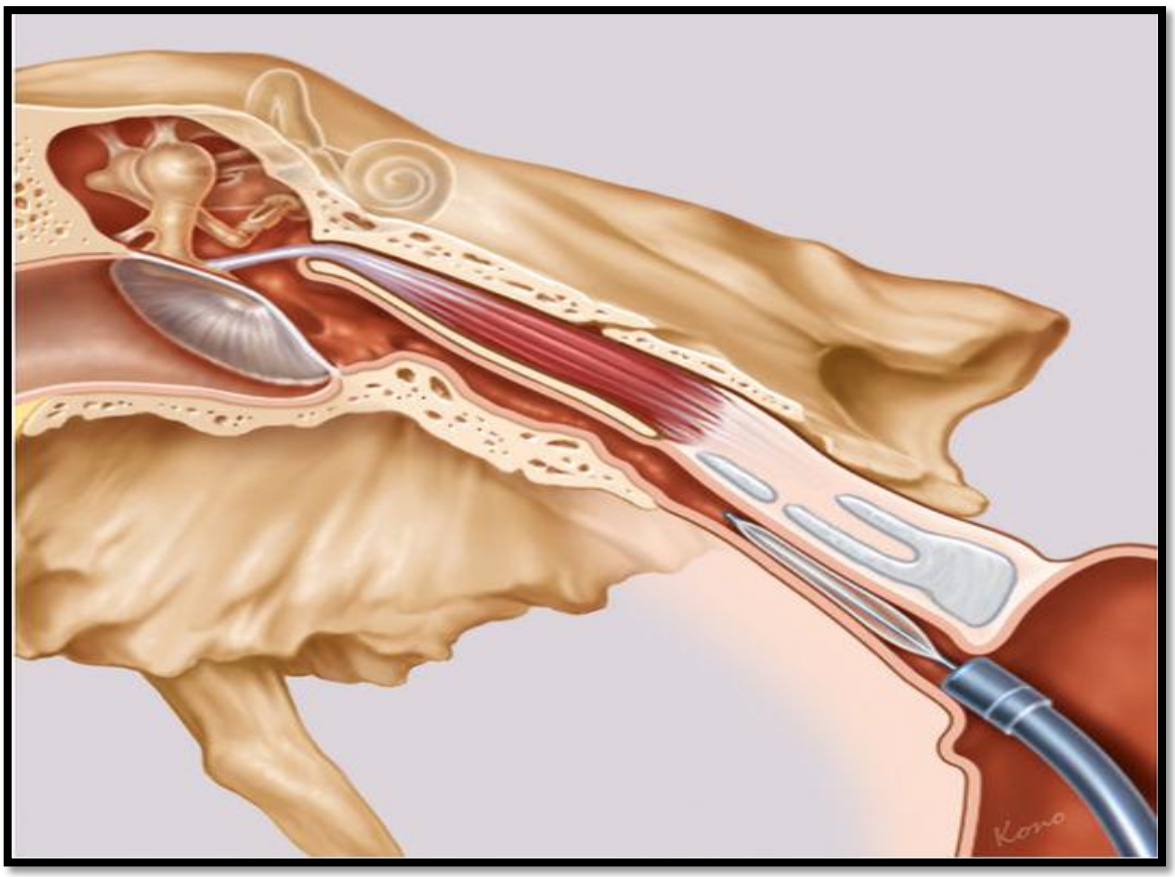
Politzer test:

This test was performed by pressing one nostril into which the end of a rubber catheter is attached to an air bag had been inserted while the other nostril was compressed with pressure from the fingers. The patient was asked to repeat the alphabet “k” or the patient was asked to swallow in order

to close the velopharyngeal opening. The assessment of the tympanic cavity pressure and its importance of the results are similar to the test described previously.

Eustachian tube catheterization:

This test was done by using the metal cannula which was introduced into the nasopharyngeal end of the Eustachian tube and a positive pressure was applied, successful transfer of applied positive into the tympanic cavity clinches the functioning auditory tube.



TESTS OF VENTILATORY FUNCTION:

This test can be assessed by manometry, sonotubometry and tympanometry.

Manometry:

This manometric test of tubal function has been conducted for the past 100 years. This technique involves the placement of external auditory canal catheter with an airtight connection between a pressure monitoring device and the tympanic cavity. The middle ear pressure can be measured

- Directly in the perforated tympanic membrane (i.e) the ***intratympanic manometry***.
- Indirectly by measuring the changes in the ear canal pressure in intact tympanic membrane the change in the ear canal pressure called as the ***extratympanic manometry***.

I. Non intact tympanic membrane:

The systematically conducted inflation and deflation test was the first quantitative tubal function performed by the intratympanic manometry. The addition of flowmeter to the manometric system to involve pressure flow relationships during the pharyngotympanictube tube function testing was the next improvement in the technique.

In the previous years only the active function of the nasopharyngeal tube was done. Later, ***bluestone and co-workers*** introduced the modified

inflation- deflation test by which the passive function could also be described by the variables such as forced opening pressure and closing pressure of the tube.

In later days the forced response test were developed to differentiate between the normal and abnormal nasopharyngeal tube function. This test eliminates the overlap encountered in the inflation and deflation test. With this forced response test, it has been possible to distinguish between the tubal dysfunction which arises as a result of inefficient opening and structural properties of the tube.

II. Intact tympanic membrane:

For the individuals with the intact tympanic membrane, the tubal function can be determined by using the two techniques such as

I. Pressure flow technique

II. Microflow technique

The second method is more reliable than the first one. This method was done by the continuous recording of the volume deviation of the tympanic membrane arising due to changes in the ambient pressure and changes in pressure within the tympanic cavity. Since this method needs a pressure chamber and advanced Instrument, which is possible, only at the upgraded institutes.

Sonotubometry:

This is a non invasive technique and provides the information about the active tubal opening. Here in this technique a tone of frequency greater than 5 kHz was presented to the nose and its recording taken from the ear through a microphone. The tone was heard louder when the tube was patent.

Tympanometry:

In tympanometry there are five methods for the evaluation of the auditory tube. Of these nine steps inflation and deflation test was more routinely used. Each of these methods was based on the indirect determination of the middle ear pressure under various conditions.

However only the, relative qualitative information can be obtained by the above methods. Hence there was no true satisfactory clinical test for detecting the tubal function with the intact tympanic membrane.

TESTS OF MUCOCILIARY FUNCTION:

The ciliary function is an active function; hence the mucociliary action of the mucous membrane was responsible for the transport of materials from the tympanic cavity into the auditory tube. The mucociliary function of the Eustachian tube can be evaluated by the radiological contrast media, fluoresceine, methylene blue etc. the time taken for the particles

which was placed in the middleear to its destination was calculated and hence the pathological state of the mucous membrane was estimated.

PHONOTUBOMETRY:

This method uses the fiberscope to observe the tubal orifice and to detect the Eustachian tube orifice by a photoelectric device. This test was done by placing a light source in the pharyngeal end of the auditory tube and a highly sensitive photodiode was placed in the external auditory canal which detects the tubal opening by the increased luminosity in the tympanic cavity.

The disadvantage of this method was that the light conduction inside the opened tube was blocked by several factors such as middle ear effusion, fluid retention within the tube and anatomical deviation of the tube.

Xe133GAS:

The ***kirchner*** in ***1974*** obtained the first scintigram of the air containing spaces of the ear and the paranasal sinuses with the ^{133}Xe. This test was done by using a bolus of ^{133}Xe gas insufflated into the nasopharyngeal space through a tube combined with the Valsalva manoeuvres. A significant difference between the sides of dysfunction and the normal tubal function has been noted.

HISTORCAL REVIEW:

The Eustachian tube was described by the ***Alcmaeon*** of Sparta in 400 BC [1][2]. He constructed the basis for understanding the medicine through the dissections and proposed the idea, that this tube helps the goat to breathe through their ears.

This was followed by the Greek philosophers, ***Aristotle and celsus*** who vaguely described about the existence but he did not elaborate its functions [4].

*'**Andrews Vesalius**'* during the period 1514-1564 professor of anatomy of Padua provided the detailed description about the tiny bones in middle ear but even though he has the knowledge of the Eustachian tube but he had not commented about this tube.

'Bartholimus Eustachius' during the period 1510-1574 described anatomy of the Eustachian tube in his book "***epistola de auditus organis"*** (examination of the hearing organs). According to him, the auditory tube originates at the anteriorly from the skull base and courses towards the pterygoid process of the sphenoid bone and it consists of two parts, the upper part is attached to the temporal bone ,remains in proximity with the tympanic cavity. The lower part is soft and partially ligamentous and partially cartilaginous which is directed to the nasopharynx.

Transverse section of the tube is not exactly rounded and the inner part was two times as width.

He compared Eustachian tube with '***quill'*** pen. Thus eustachius provided the precise description of its morphology and its location in the face, not mentioning about its function.

The French anatomist ***Guichard joseph Duverney*** (1648-1730) described the function of nasopharyngeal tube as the means for introducing the air within the middle ear for maintaining the pressure. He also believed that this tube remains open in most of the times and it is the ear drum that maintains the air to flow.

Finally the ***Antoine Marie Valsalva*** during the period 1666-1732 was credited for giving the tube its eponymous name in honor of ''eustachius'' and his study paved the way for understanding the ear anatomy and physiology. ''***Valsalva''*** was a student of the famous ''***physician Maricello Malpighi''***, designated as the Anatomy Professor in the Bologna University during the year 1705, the area of interest was the middle & inner ear anatomy and physiology.

In 1705, ''***Valsalva''*** had published '***de aura Humana tractus***' after the intense observations, animal experiments of the physiology and pathology of the ear. He also demonstrated the connection between the air cells in the

mastoid and the middle ear cavity. Thereby he explained the functions of the Eustachian tube and its diagnostic importance. He believed the obstruction of the Eustachian tube as the cause of deafness and he also described a method of forced expiration of air through the nasopharyngeal tube with the closed mouth and nose which results in an increased pressure within the ear drum.

Antonio Maria Valsalva (1666–1723). Described autoinflation of the eustachian tube and middle ear by the patient and in 1707 first observed fluid within the labyrinth.

This is still now the procedure called the Valsalva s test for detecting the tube patency and to distinguish between the perforation and retraction. This procedure has been used by the Arab physicians during the 11th century for the purpose of clearing the middle ear pus and there by the ear block was released and hence the hearing was restored.

REVIEW OF LITERATURE

The evaluation of Eustachian tube function is one of the prerequisites for successful middle ear surgeries and mastoidectomy. The pathologies in the nose and nasopharynx is likely to affect the Eustachian tube function and thereby it hampers its normal function such as ventilation, mucociliary clearance and protective function, consequently the middle ear is directly affected by alteration in the Eustachian tube function. There are various quantitative and qualitative methods have described in the literatures yet no single method is perfect in all respects.

LARSEN et al in 1976 assessed the function of Eustachian tube function in 44 patients with dry perforations of the tympanic membrane by means of the saccharin test, the aspiration test and by the Valsalva manoeuvre. They found that there is no relationship between the results of above mentioned tests. However a correlation seems to exist between the hearing improvement obtained as determined by the postoperative air-bone gap, the positive or negative results of the saccharin test, and the saccharin perception time.

GIMENEZ et al in 1993 studied the mucociliary and equipressive Eustachian tube functions, using 5% sodium sacharinate and tubal manometry in 58 ears with chronic disease undergoing tympanoplasty. The

position of the perforation site determines the results, as the poorest results are obtained from the posterior ones. Significant differences in transport times have been noted for the anterior and posterior perforations, being shorter for the anterior ones. When the surgical outcome is correlated with mucociliary transport , the normal transport time percentage is seem to be considerably higher in the success group (50%) than in the failure group (22%).

VALLES et al in 1981 tubal manometry and clearance time study in 78 patients. They found that in cases of normal equipressive function, clearance time was considerably better than in those tubes with manometric dysfunction or blocking, with no significant differences between these two cases.

NUUTINEN et al in 1983 measured the mucociliary function of the Eustachian tube with a radio isotopic method using 0.01 ml of a serum albumin labeled with technetium 99m. They concluded that the mucociliary function was totally absent in chronic otitis media in untreated secretory otitis media, and in the ear with a moist perforation of the tympanic membrane. The mucociliary transport time returned to normal when the ear was clinically healed.

ROGERS et al in 1962 evaluated the Eustachian tubal function by fluorescent dye studies. He concluded that tympanic injection of fluoresceine dye followed by ultra violet examination of the pharynx is a safe, rapid and reliable method for determining patency or obstruction of the Eustachian tube.

SRIVASTAV et al in 1993 studied 35 patients with perforated ear drums and 15 cases with intact ear drums and Eustachian tube function was assessed by saccharin test, Bortnick-miller test and manual impedance Audiometry. The merits and demerits of one over another were evaluated. It was observed that more than one test when employed provides better information as every test has its own advantages and limitations.

SADE in 1966 did an extensive study on middle ear mucosa. He proposed that ciliary tract has a direct bearing on the clearance function of the middle ear in health and disease. The mucous forming structures while serving to moisten cilia under physiologic conditions are responsible for at least part of the mucus found in pathological conditions in the middle ear mainly in serous otitis media.

SADE in 1967 reported qualitative studies on the function of the ciliary pathways in the human middle ear. This was done by observing and photographing the movement of foreign materials over the mucus blanket in the middle ear. Their experiments showed that ears with large dry central

perforations where the mucosa looked normal, probably representing normal middle ear mucosa, can actively clear foreign material towards and into the Eustachian tube. This takes place in definite tracts with the help of a mucous blanket, topographically from the same area where cilia were demonstrated histologically.

JESIC et al in 2004studied the mucociliary transport of Eustachian tube in patients with COM by means of saccharin test. The results of their study indicate the possibility that prolonged mucociliary tube transport has greater influence to development of atticoantral otitis rather than to development of tubotympanic otitis. The association between the degree of mucosal defect and time of transport was evidenced in both types of COM in middle ear.

MEGERIAN C in 2000 did a study on pediatric tympanoplasty and the role of preoperative Eustachian tube evaluation. His hypothesis was whether paediatric tympanic membrane perforations can be successfully repaired if the child can taste the otologic drops successfully, provided that the paediatric patients must be mature enough to reliably report the taste of an ear drop.

BLUESTONE et al in1979 studied the Eustachian tube function in relation to the results of tympanoplasty in 45 children. Pre operative assessment of Eustachian tube function using modified inflation deflation test failed to predict the success of tympanoplasty. Children remain uncertain candidates

for tympanoplasty surgery since, as a group, their Eustachian tube function are not as good as that of adults.

TAKAHASHI et al in 1989 studied Eustachian tube function in children with secretory otitis media. They concluded that the pathogenesis of long lasting secretory otitis media involves both a fundamental defect in negative pressure equalizing function and secondary impairment of the clearance function of the Eustachian tube.

MANNING et al in 1987 studied the prognostic value of the Eustachian tube function in paediatric tympanoplasty. They tested the tubal function in 63 ears undergoing tympanoplasty for central perforations. They found that Eustachian tube function according to inflation-deflation and forced response test results were predictive of the operations success not failure.

BRENNER et al in 1997, in their study concluded that ventilation scintigraphy procedure was easy to perform and had a success rate of approximately 70%.

KARASEN MR et al in 1999 evaluated Eustachian tube function by ventilation scintigraphy by 50 MBq 133Xe. 13 patients with normal tube function and 16 with one sided tube dysfunction were subjected to this procedure. They noted significant differences between the sides of

dysfunction and normal tube function and also between sides of dysfunction and both sides of controls.

SIDENTOP et al in 1972 assessed the relationship of Eustachian tube function and size of mastoid air cell system (SMACS) in ears with chronic otitis media before tympanoplasty. They concluded that it is more reliable to base prediction of surgical success on preoperative tubal function than on size of mastoid air cell system; and further, that trying to predict surgical success from the combination of Eustachian tube function and SMACS does not enhance the accuracy of the prediction.

HOLMQUIST et al in 1970 in cases with chronic otitis media, was the first to study the relationship between Eustachian tube function, size of mastoid air cell systems and healing. The authors found a relationship between the size of the mastoid air cell system and Eustachian tube function. Poor Eustachian tube function and a small mastoid air cell system in poor long term results after myringoplasty.

MATERIALS AND METHODS

This prospective study was conducted at the department of ENT AND HEAD & NECK SURGERY, THANJAVUR MEDICAL COLLEGE AND HOSPITAL, THANJAVUR, TAMILNADU for a period of two years from august 2012- August, 2014. The study group consists of 60 patients of chronic suppurative otitis media of both Mucosal and Squamous type. The detailed history was taken & clinical features of CSOM are noted.

***INCLUSION CRITERIA*:**

- CSOM- tubotympanic inactive and quiescent stage
- CSOM-atticoantral type

***EXCLUSION CRITERIA*:**

- Age less than 15 years.
- Fungal infections of the ear
- Any tumour or mass in the nasopharynx causing the Eustachian tube dysfunction.
- Complete ENT examinations were performed to rule out any Systemic disease which affects the end result of mastoid and middle ear surgeries.

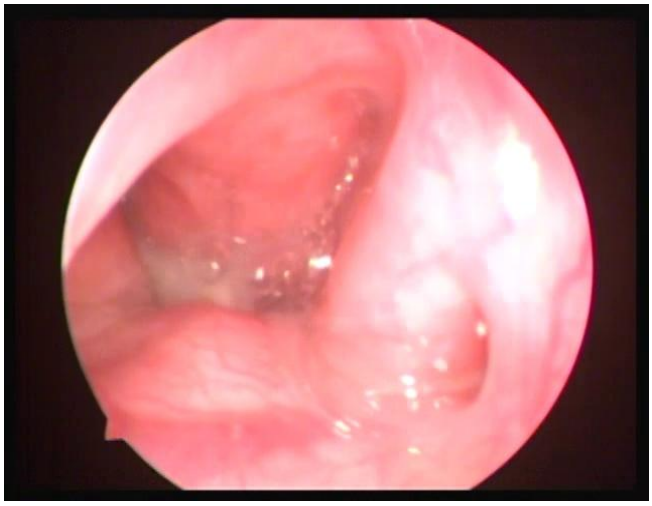
The patient (under study) planned for the tympanoplasty was subjected to the following investigations.

OTOENDOSCOPIC EXAMINATION:

By using the o^0/4mm Hopkins rod, about the condition of the middle ear and the type of disease is evaluated. Based on the site of perforation, the type of disease decided. The condition of the middle ear and its mucosa and the ossicular status and ear drum status were noted.

DIAGNOSTIC NASAL ENDOSCOPY:

The patients were assessed after the nasal packing with 4% lignocaine and xylometazoline drops for 15 minutes. Then using the 0^0/4mm Hopkins rod, detailed examination of the lateral nasal wall was done with special emphasis on the opening and closure of the proximal end of the Eustachian tube.



ASSESMENT OF EUSTACHIAN TUBE FUNCTION:

The ventilatory and the mucociliary functions of the auditory tube were assessed preoperatively in all the patients by the following methods and their results were compared.

VALSALVA TEST:

This test has been done by using the effect of high positive nasopharyngeal pressures on the Eustachian tube. If the tube is patent we can see the bulging or the movement of the tympanic membrane. In partial dysfunction and absent function restricted to absent movement is appreciated. This can be visualized either with the help of otoscope or otoendoscope. The patients subjected to this test were asked to inflate the Eustachian tube by asking them to do a forced expiration against closed glottis and the nostrils were held between the forefinger and thumb. This is the most sensitive and valuable test.

SIEGALIZATION:

The patients subjected to this test were done by using snugly fitting ear speculum and Siegel's bulb attached to the otoscope. The gush of air is transferred into the external auditory canal and then over the tympanic membrane to produce a movement of the membrane, provided there should not be any adhesions between the membrane and the middle ear.

In case of perforated membrane, there is no change in the position of the membrane. This test is a simple and cost effective test can be done in all the patients to detect the ventilatory function.

SACCHARIN TEST:

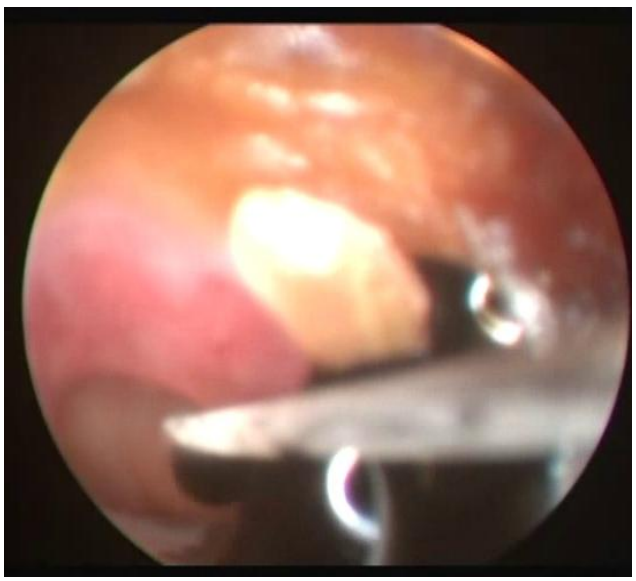
This is done as OPD procedure, with the patients in the lying posture by using the microscope the saccharin powder is kept in the middle ear through the perforation. Then the time required to feel the sweetness has been measured.

If the patient could not taste the saccharin over 45 min then his/her taste sensation of the anterior 2/3 of the tongue was also tested, if both was negative the result was designated as no response. Thus the results of this test were classified into three groups as follows:

EUSTACHIANTUBE FUNCTION	**SACCHARIN PERCEPTION TIME**
NORMAL	*<20 MIN*
PARTIAL DYSFUNCTION	*20-45 MIN*
GROSS DYSFUNCTION	*>45 MIN*

METHYLENE BLUE DYE TEST:

4-6 drops of sterile blue dye was placed using the operating microscope on the middle ear mucosa though the defect in the tympanic membrane. By using the 0^{o} Hopkins rod the nasopharyngeal end of the Eustachian tube orifice focused.



The results of this were analyzed and classified into three groups as follows:

EUSTACHIAN TUBE FUNCTION	METHYLENEBLUE CLEARANCE TIME
NORMAL	< 10 MIN
PARTIAL DYSFUNCTION	10- 20 MIN
GROSS DYSFUNCTION	>20 MIN

TREATMENT:

The patients planned for the tympanoplasty is initially investigated with the above tests and classified as the normal, partial, absent Eustachian tube function. Those patients with the partial, absent Eustachian tubal function, with active inflammation and discharge from the middle ear were selected the treatment plan of oral antibiotics, topical ear drops (Neosporin –H), twice a day steam inhalation, twice a day bubble gum chewing, twice a day balloon blowing for the span of four week in order to restore the tubal function as far as possible.

Then again the patient was subjected to the all the above tests, in addition to the tympanometry for the Eustachian tubal function and finally categorized into as normal, partial, absent Eustachian tube function. The patients were posted for the surgery regardless of the final result about the Eustachian tubal function. The surgery was done through the William

wilde's postaural approach, the graft used for this procedure was taken from the temporalis fascia.

By using the 0^{o} Hopkins rod the tympanomeatal flap raised though the incision from the 6^{o} clock and 12^{o} clock position the middle ear cavity explored and the (marked) polypoidal mucosa, granulation tissue in and around the Ossicles, around the Eustachian tube orifice were removed and the osseous end of the tube is then temporarily packed with the gelfoam soaked with the adrenaline to reduce the edema around the tubal orifice.

Ossicular chain was Integrity checked by eliciting the round window reflex. During the entire procedure the normal mucosa and the anatomical landmarks were preserved as far as possible. The eroded Ossicles were removed which was later used as an autologous graft for the ossiculoplasty. The mastoid cavity drilled by using the electrical burr, the antrum, the aditus were identified, the diseased air cells and the granulation tissue were removed.

The cholesteatoma found along the way were removed. Depending upon the disease pathology the simple or modified radical mastoidectomy was done to the patient. The harvested temporalis fascia was kept in the underlay technique with anterior tucking done. The ossicular chain reconstruction was done in patients with eroded Ossicles simultaneously, the ossicular graft was stabilized by the gelfoam and the middle ear packed

with the gelfoam in order to support the temporalis fascia graft. Wide meatoplasty was done in patients with canal wall down mastoidectomy for the further follow up in the future. The mastoid cavity obliteration was done by using the surrounding subcutaneous tissue and the temporalis muscle pedicled flaps.

The wound closed and an aural pack with the povidone iodine gauze piece which has to be removed on 21st post operative day. Intravenous antibiotics and the analgesics were given in the postoperative period; the sutures were removed in the 7th or 9th pos operative day depending upon the condition of the wound. After discharge the patients were reviewed once in 15 days for 3 months and once a month for another 3 months.

The graft status was assessed by the otoendoscopy once in 15 days, at the end of the 3rd month the graft was assessed again with the otoendoscopy, tympanometry and pure tone Audiometry, even though the outcome was not measured based on the results.

Thus the outcome of the surgery was measured in the postoperative period which was divided into as follows,

a) Successful - the healed graft with proper middle ear aeration.
b) Retracted or atelectatic graft.
c) Graft failure or perforation of graft secondary to otitis media.

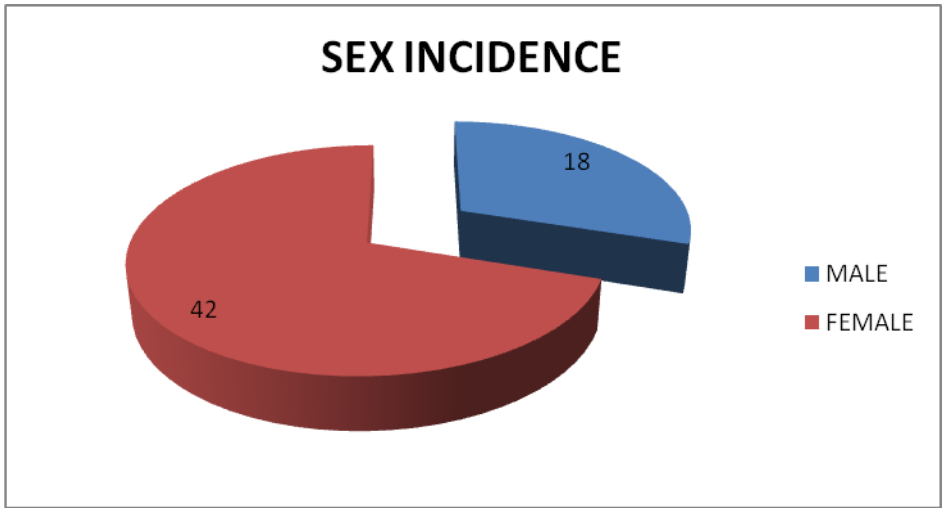
The later two outcomes (b and c) were taken as failures.

RESULTS AND OBSERVATIONS:

This clinical study had been done in the department of *ENT AND HEAD & NECK SURGERY, THANJAVUR MEDICAL COLLEGE AND HOSPITAL, THANJAVUR, TAMILNADU* for a period of two years from august 2012-August 2014. The study group consists of 60 patients of chronic suppurative otitis media of both tubo tympanic and attico antral type.

***SEX INCIDENCE*:**

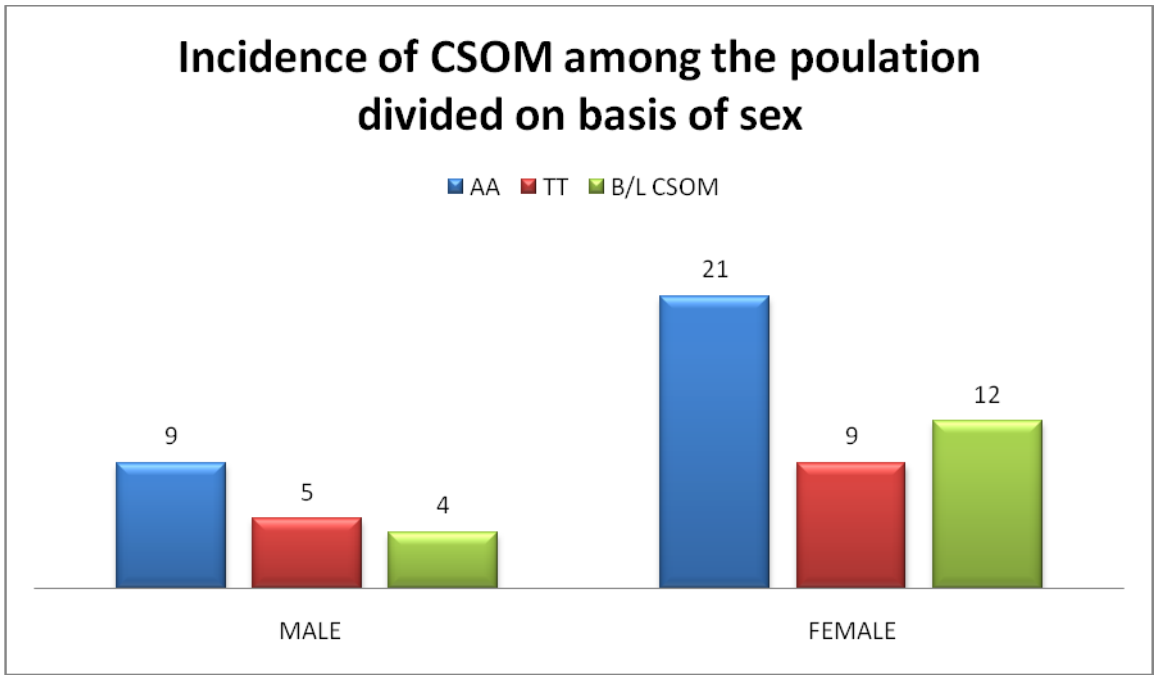
SEX	NO. OF PATIENTS	PERCENTAGE
MALE	18	30
FEMALE	42	70



Thus in our study 18 patients were male and 42 patients were female, it shows that the females were the more affected group.

CASE DISTRIBUTION OF VARIOUS TYPE OF CSOM AMONG THE POPULATION DIVIDED ON BASIS OF SEX

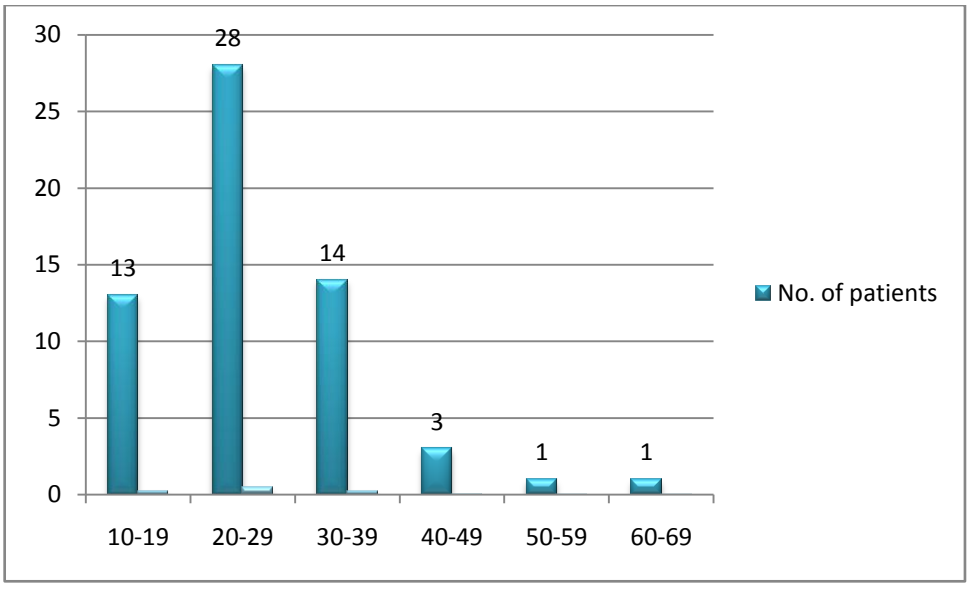
SEX	B/L CSOM			R CSOM		L CSOM		Total no. of patients
	AA	TT	AA&TT	AA	TT	AA	TT	
MALE	0	3	1	6	2	3	3	18
FEMALE	2	10	0	5	4	16	5	42



Our study shows that the females have more incidence of CSOM of AA type that to the left side was more common. The male population has more incidence of CSOM of AA that to the right side was more common. The incidence of bilateral CSOM was more common in the females than the males

OVERALL INCIDENCE OF CSOM AMONG THE VARIOUS AGE GROUPS

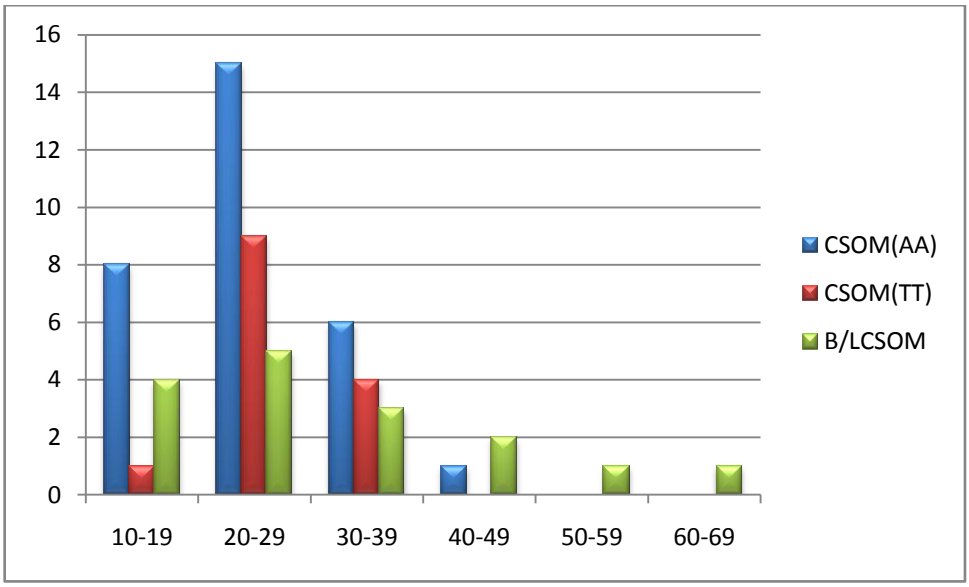
Age in years	No. of patients	% of study group
10-19	13	21.67%
20-29	28	46.67%
30-39	14	23.33%
40-49	3	5%
50-59	1	1.67%
60-69	1	1.67%



Thus in our study the incidence of CSOM was more common among the age group 20-29 and followed by 30-39 years.

AGEWISE DISTRIBUTION OF VARIOUS TYPE OF CSOM AMONG OUR STUDY GROUPS

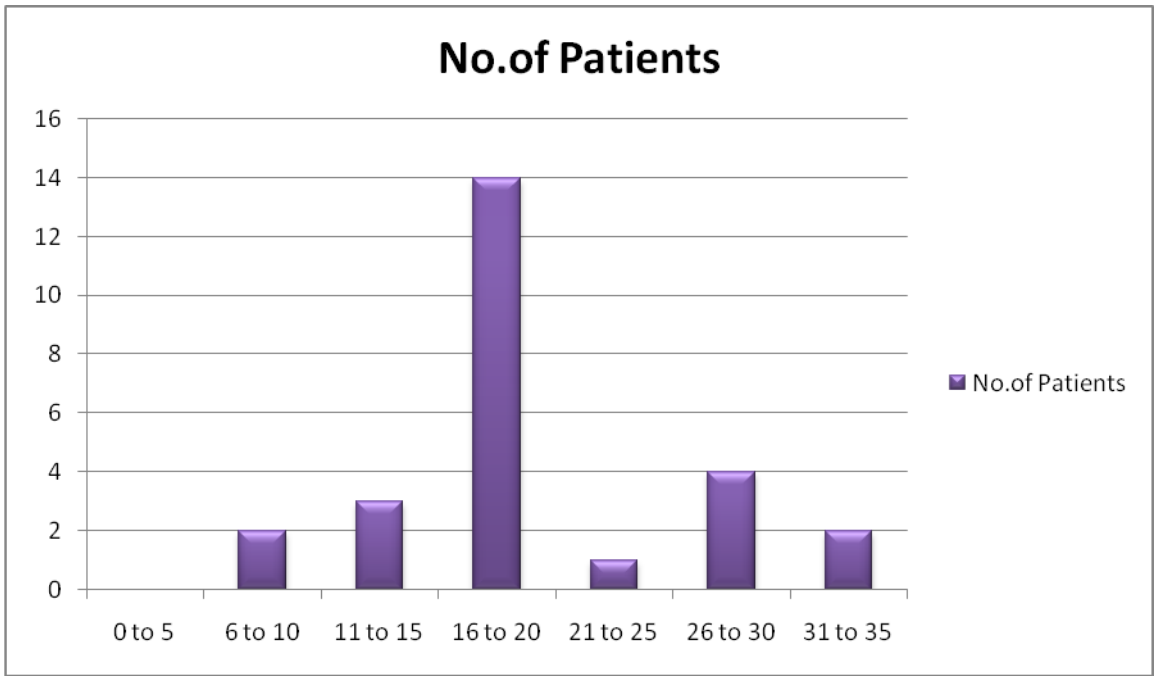
Age groups(years)	*CSOM(AA)*	*CSOM(TT)*	*B/LCSOM*
10-19	8	1	4
20-29	15	9	5
30-39	6	4	3
40-49	1	0	2
50-59	0	0	1
60-69	0	0	1



The results of our study shows that the CSOM of AA type was the most common type in the age group 10-40 years and followed by CSOM of TT type but after the age of 40 years the incidence of bilateral CSOM was more than the unilateral attico antral type or tubotympanic type.

SACCHARIN PERCEPTION TIME AMONG THE PATIENTS

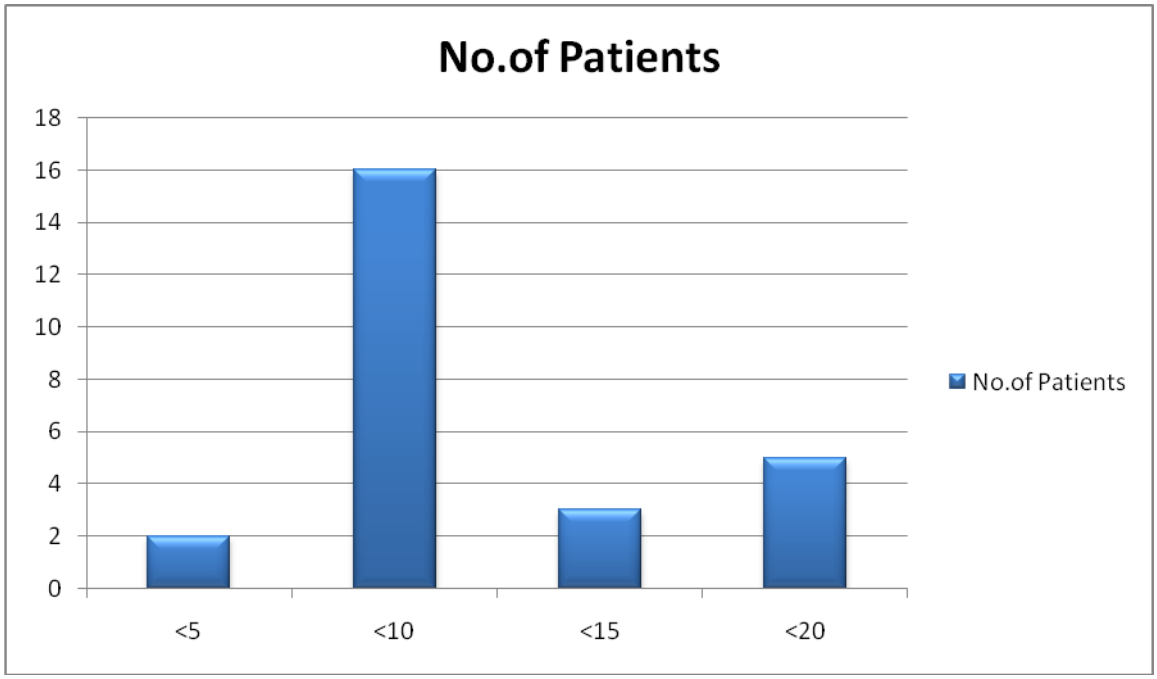
Time(min)	*Total no of patients*
0-5	0
6-10	2
11-15	3
16-20	14
21-25	1
26-30	4
31-35	2



The results of our study shows that about 19 patients are having the saccharin perception time within the normal limits and 7 patients fall in the category of partial dysfunction (ie) they are having the saccharin perception time of more than 20 minutes but less than 40 minutes.

METHYLENE BLUE CLEARANCE TIME AMONG OUR STUDY GROUP

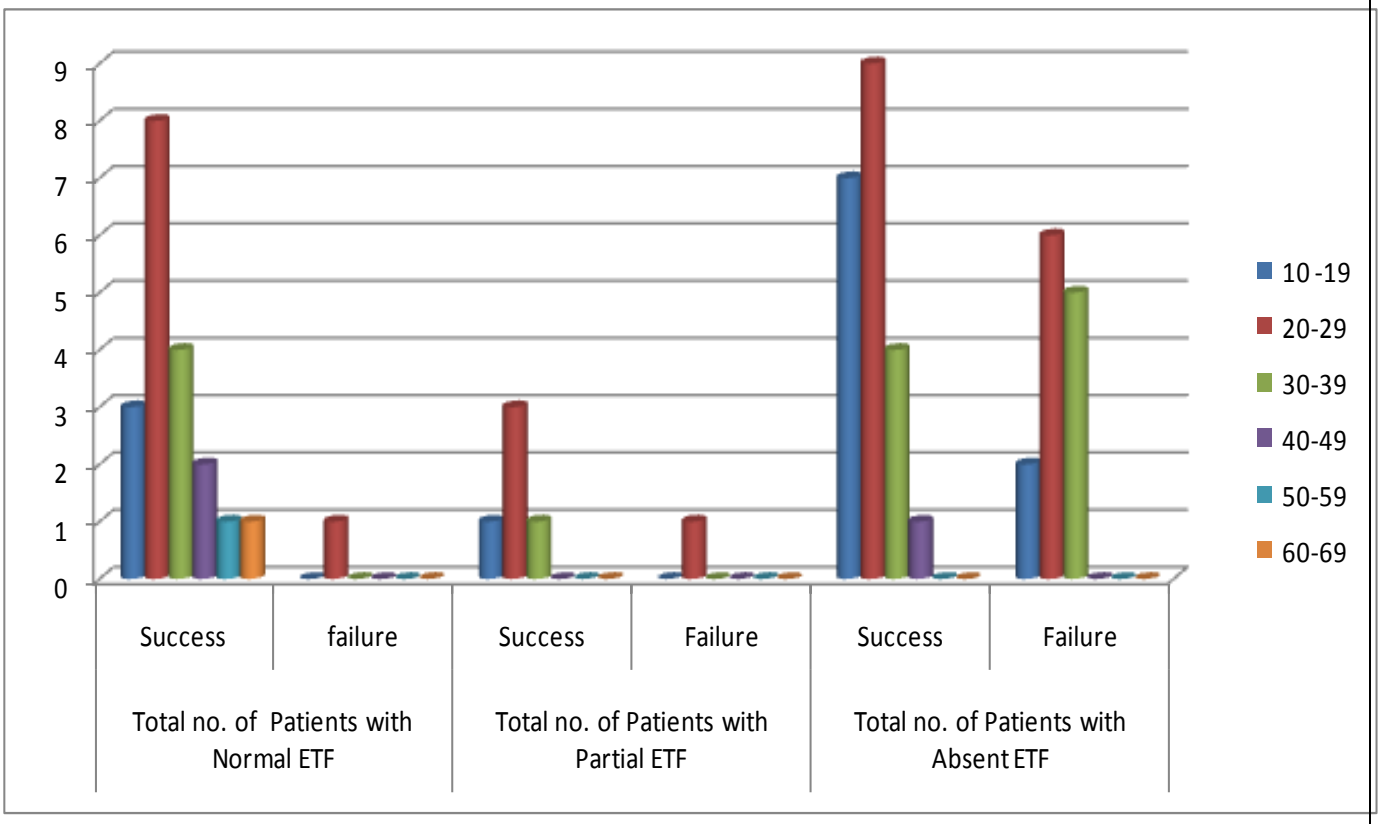
Time(min)	*Total no of patients*
0-5	2
6-10	16
11-15	3
16-20	5



The study shows that about 18 patients fall within the category of normal Eustachian tube function and about 8 patients fall in the category of partial dysfunction. The rest of the patients were considered as the absent tubal function as their clearance time was more than 20 minutes.

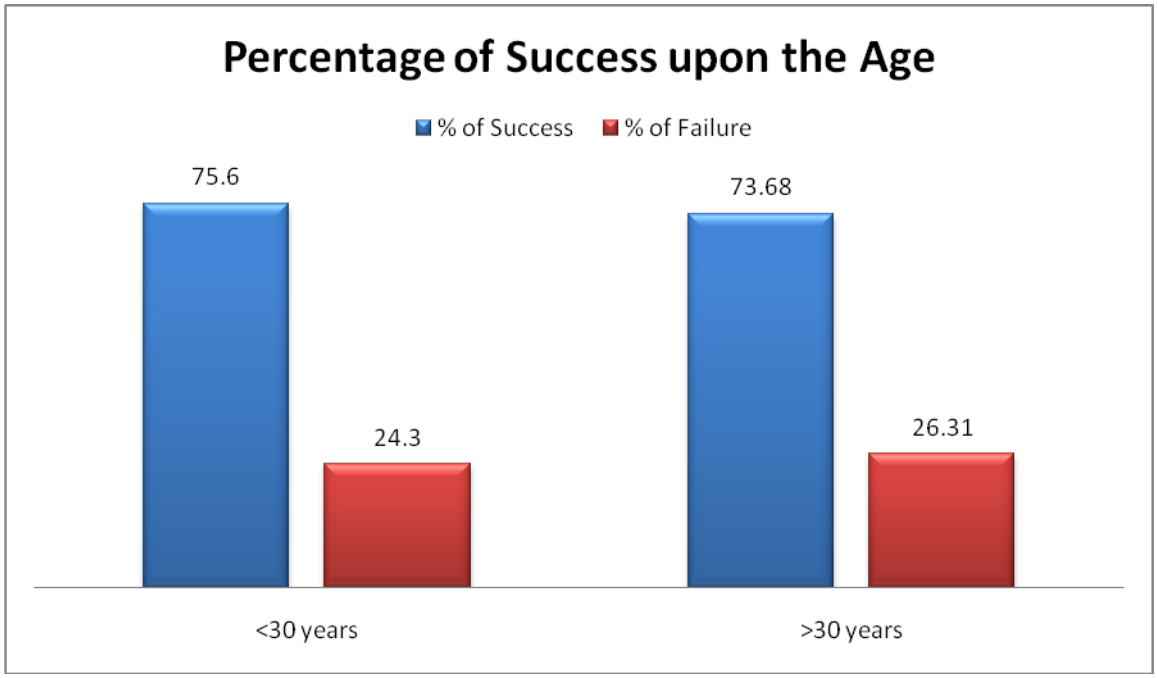
PREVALENCE OF SUCCESS AND FAILURE OF THE PROCEDURE WITH THE VARIOUS AGE GROUPS

Age group	Total no. of Patients with Normal ETF		Total no. of Patients with Partial ETF		Total no. of Patients with Absent ETF	
	Success	Failure	Success	Failure	Success	Failure
10-19	3	0	1	0	7	2
20-29	8	1	3	1	9	6
30-39	4	0	1	0	4	5
40-49	2	0	0	0	1	0
50-59	1	0	0	0	0	0
60-69	1	0	0	0	0	0



COMPARISION OF SUCCESS RATE WITH THE AGE

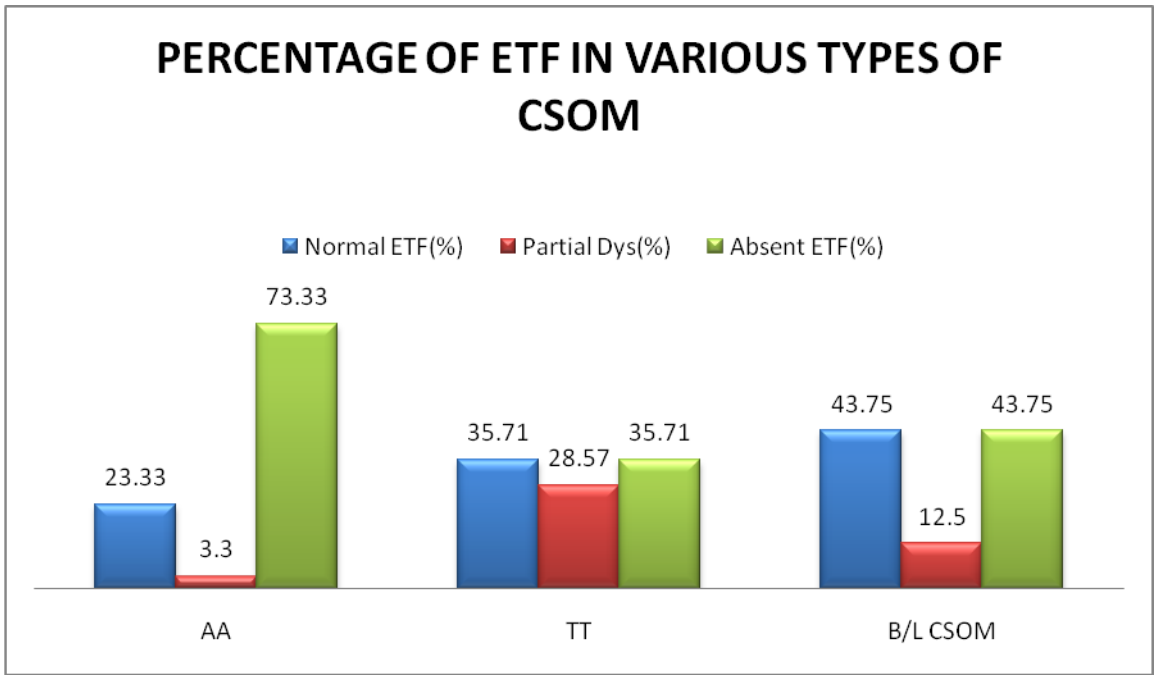
Age	Total no of patients	% of success	% of failure
<30 years	41	75.6	24.3
>30 years	19	73.68	26.31



Thus in our study there is no much differences in the success and failure rate in the above age groups.

PERCENTAGE OF ETF IN VARIOUS TYPES OF CSOM

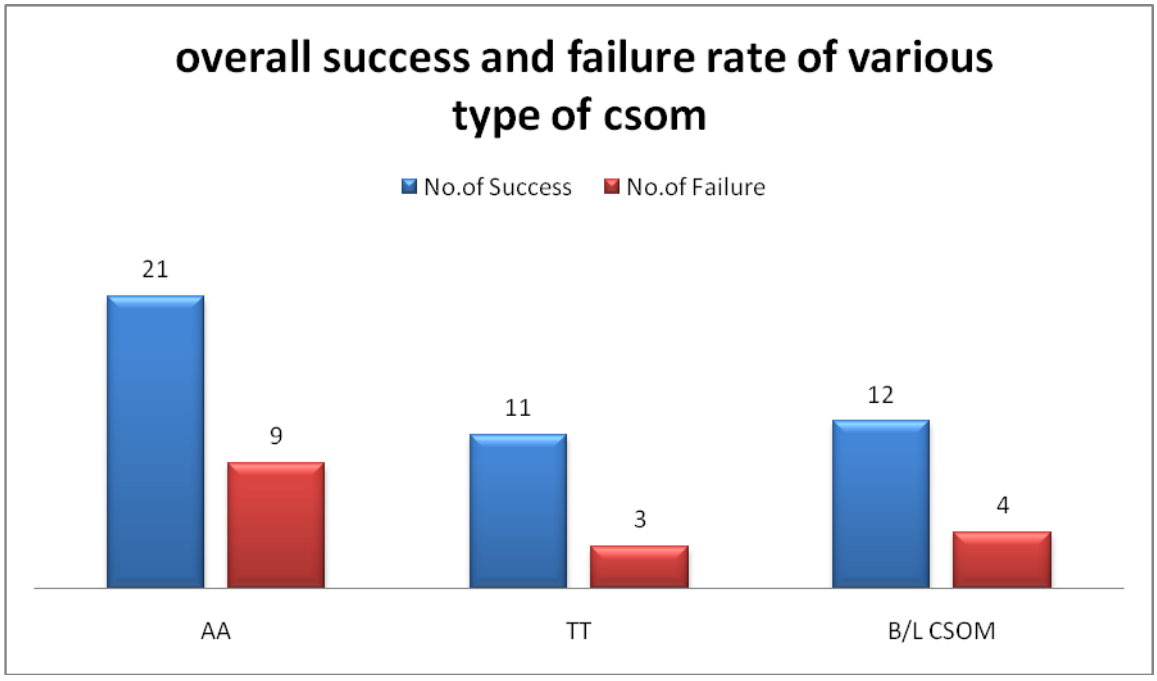
ETF	AA	TT	B/L CSOM
Normal function	23.33%	35.71%	43.75%
Partial dysfunction	3.3%	28.57%	12.5%
Absent function	73.33%	35.71%	43.75%



The results of our study show that the percentage of normal functioning Eustachian tube was present to be highest in the cases of bilateral CSOM and followed the unilateral CSOM of tubo tympanic type. But when comparing the absent tubal function, it is lesser for the unilateral CSOM of tubotympanic type than the bilateral CSOM and CSOM of attico antral type.

OVERALL SUCCESS AND FAILURE RATE OF VARIOUS TYPE OF CSOM

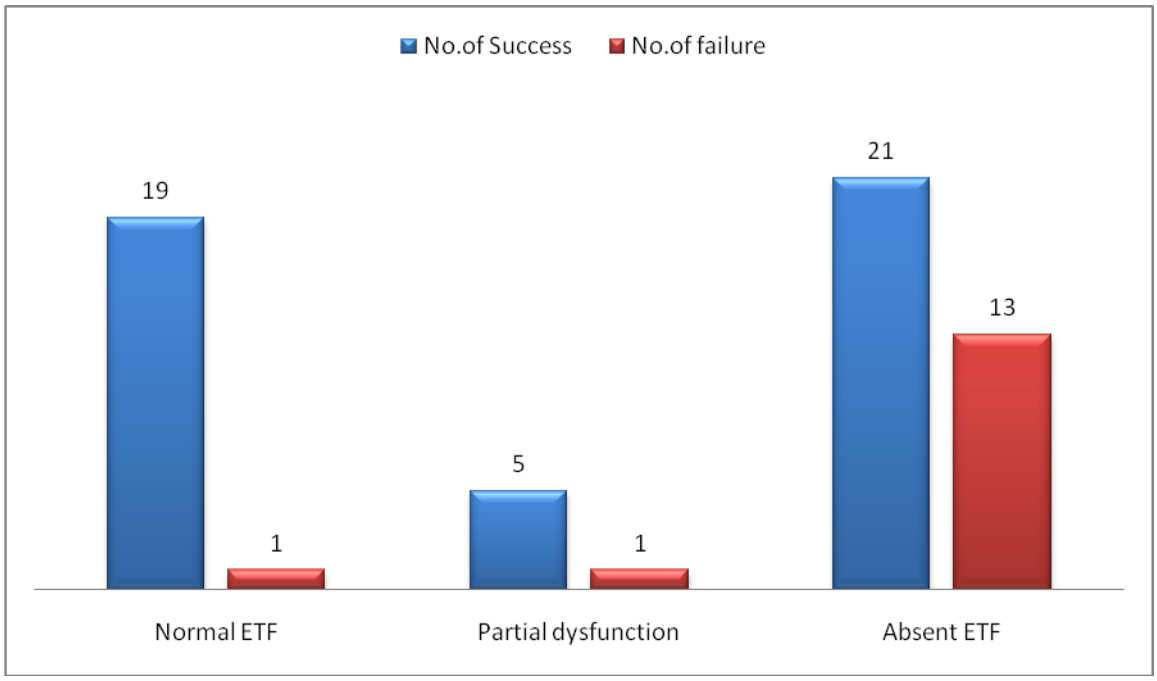
Type of CSOM	Total no. of patients	% of success	% of Failure
AA	30	70	30
TT	14	78.57	21.43
B/L CSOM	16	75	25



The study shows that the percentage of success was higher in the CSOM of tubo tympanic type followed by the bilateral CSOM and CSOM of attico antral type

COMPARISION OF PERCENTAGE OF SUCCESS AND FAILURE RATE WITH VARIOUS TYPE OF EUSTACHIAN TUBE FUNCTION

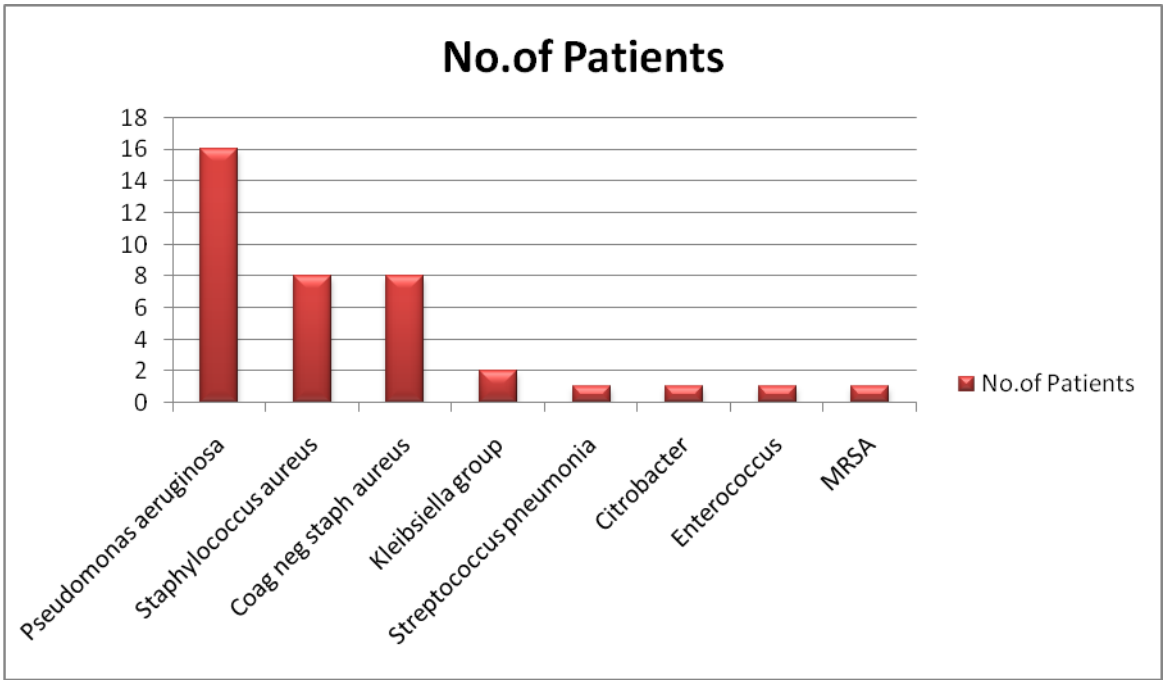
Eustachian tube function	Total no. of patients	% of Success	% of failure
Normal ETF	20	95	5
Partial dysfunction	6	83.33	16.67
Absent ETF	34	61.76	38.24



The results of our study show that the percentage of success in the CSOM with the normal tubal function was higher than the CSOM patients with the partial dysfunction and absent tubal function. The results of our study were significant having the “P” value of 0.001466. Thus the result of our study reflects that the normal functioning Eustachian tube is the most important prerequisite for any type of tympanoplasty.

PREVALENCE OF VARIOUS TYPES OF ORGANISMS IN OUR STUDY GROUP

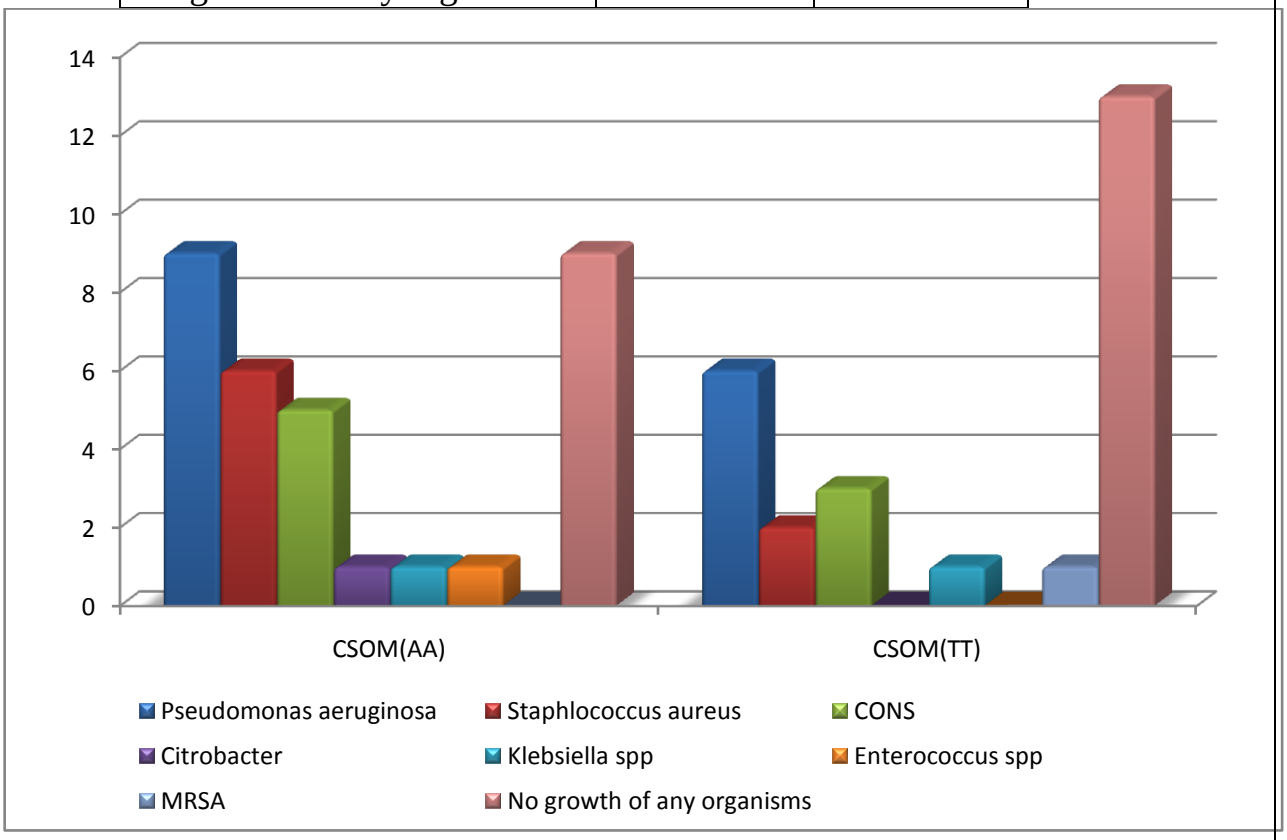
Name of the organisms	***Total no of patients***
Pseudomonas aeruginosa	16
Staphylococcus aureus	8
CONS	8
Klebsiella spp	2
Streptococcus pneumonia	1
Citrobacter spp	1
Enterococcus spp	1
MRSA	1



The results show that the organism Pseudomonas aeruginosa is the commonest still now. And the other organisms that are emerging to be the next were the staphylococcus aureus and the CONS.

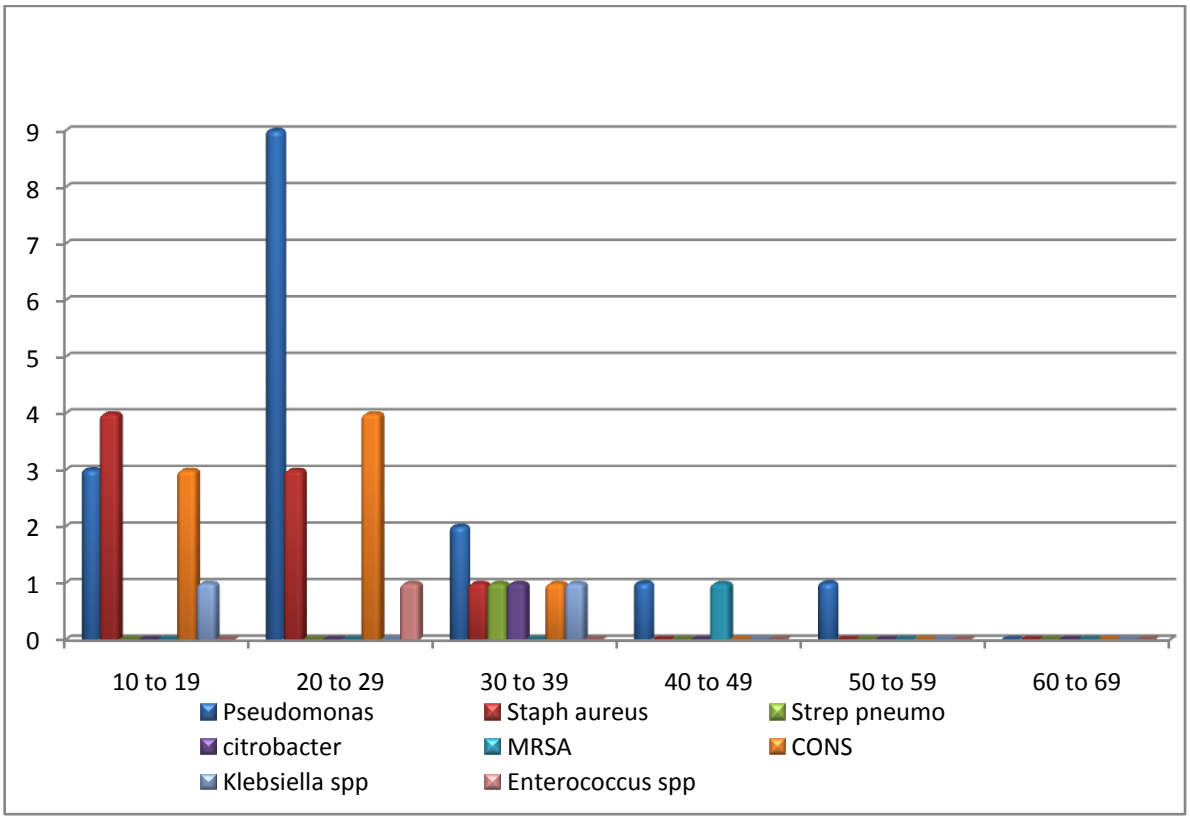
*PREVALENCE OF ORGANISMS IN VARIOUS TYPES OF CSOM**

Name of the organisms	*CSOM(AA)*	*CSOM(TT)*
Pseudomonas aeruginosa	9	6
Staphlococcus aureus	6	2
CONS	5	3
Citrobacter	1	0
Klebsiella spp	1	1
Enterococcus spp	1	0
MRSA	0	1
No growth of any organisms	9	13



Age wise distribution of prevalence of organisms in our study group

Age	Pseudomonas	Staph aureus	Strep pneumo	Citrobacter	MRSA	CONS	Klebsiella spp	Enterococcus spp
10-19	3	4	0	0	0	3	1	0
20-29	9	3	0	0	0	4	0	1
30-39	2	1	1	1	0	1	1	0
40-49	1	0	0	0	1	0	0	0
50-59	1	0	0	0	0	0	0	0
60-69	0	0	0	0	0	0	0	0



DISCUSSION

The prevalence of CSOM remains a great problem in most of the developing countries including in India. About 6% of our population has the chronic suppurative otitis media and most of them belong to the rural parts[1]. The disease is found to have more incidences in the people with poor literacy and poor hygiene. Our study group comprises of the people who belongs to lower middle class group and living in overcrowded environment. Since these are the favorable environment for the middle ear diseases with initial viral infection followed by the bacterial organisms.

Even though in modern era we have wide range of antibiotics, the disease cannot be eradicated because of the various factors such as the poor immunological status of the patient, anatomical variation and physiological dysfunction of the organs and the differences in the pneumatisation of the mastoid air cells etc. Here in our study we are elaborating the role of Eustachian tubal function as one of the important prerequisites for the mastoid and the middle ear surgeries.[32]

According to the ***RagavendraReddy.R et all*** in Drainage function of Eustachian tube in suppurative otitis media, the ciliated epithelium of the auditory tube damage is related to the number of episodes of the otitis media which causes the permanent tubal dysfunction. Thus the ***impaired drainage***

function leads to CSOM and it also affects the success rate of the mastoidectomy and middle ear surgeries [33].

The study conducted by the ***Dr Kishore Chandra Prasad et all*** shows that there is not much difference in the disease prevalence among male and female population[34]. According to ***Harikrishnan et all,*** greater percentage of females are willing to undergo surgery compared to males due to increased interaction in the society [35].

In our study there is a gross difference in the incidence of CSOM about 70% in the female population and 30% in the male population. The reason may be the ***poorer literacy rate among the females in our region and lack of proper nutritious diet*** for the women. Since the family planning has been poorly implemented in our study group, the females have to share the nutritious diet to the family members, causes detrimental effects of her health.

In our study the females are having higher incidence of disease in the left side, which is more common (about 38.09% than the right side (11.90%). The unsafe type is more common than the safe type of CSOM. The male population is having higher incidence CSOM of unsafe type in the right ear of about 38.33%.The incidence of B/L CSOM is also more common in the female population of about 23.08%.

The study conducted by ***Suresh palukuri et all*** during the year 2014 reveals that the most common age groups for the CSOM were less than 35 years and constitutes about 62%[5] . Their study revealed there are about 28 patients in the age group of 20-29 years which accounts for about 46.67%. The next common age group is 30-39 years which comes around 23.33% and 21.67% in the age group of 10-19 years [36]. Even though ***the otitis media is the common disease of paediatric age group but the mean age of manifestation is the 20-29 years***[1].

But this statistics cannot exclude that the disease in the other age groups as the peoples in the rest of the age groups may not come for the treatment immediately, and may start living with the disease, and expected to visit the hospital once they had landed in the complications such as hard of hearing or any intra or extra cranial complications.

Our studies also reflect that the CSOM of AA type is more common in the younger age groups. It is about 13.33% for 10-19 years and 20-29 years it rises to 25%, followed by a decline of about 10% in the 30-39 years.

The function of the Eustachian tube is a very important prerequisite for successful tympanoplasty. The study conducted by the ***Abhinav srivastava*** et all showed that there is a ***good graft uptake*** in the patients of ***normal tubal function*** (***regardless of type of the disease***) about 91.1% of study group. They studied the ventilatory functions of the Eustachian tube by the

Toynbee`s test and classified into normal functioning tube and the tube with the impaired function [37].

The study done by the ***K.C.Prasad et all*** for assessing the results of middle ear reconstruction, the ***methylene blue dye*** and ***saccharin*** had been used to find out the ***mucociliary activity*** of the Eustachian tube[34].

The study conducted by ***Bhatta.R et all*** for the evaluating the mucociliary activity of the Eustachian tube in CSOM patients of paediatric age group ,***Gentian violet*** is used as the testing material to assess the mucociliary activity and took 16 minutes as the cut off to segregate as the absent tubal function[38].

The study of ***Vishnu Prasad et all*** used the methylene blue and the saccharin to assess the ETF[1]. They assessed the results of middle ear reconstruction and evaluated the cause of graft failure in relation to the tubal function[1].

According to ***R Bhatta et all,*** there are ***various agents*** for assessing the mucociliary activity of the tubal functions such as ***methylene blue, indigo, flourescin sodium, gentian violet***. Application of pressure on the tragal region should not be done, as it forcefully pushes the testing agents into the pharyngotympanic tube[7].

According to ***S.S Joshi et all*** Eustachian tube has three distinct functions. Each of these should be assessed separately. ***Impedance Audiometry can measure the physiological function of Eustachian tube***[39].

We used to detect the Eustachian tube function by using the combination of siegulization, Valsalva test, methylene blue and the saccharin granules and the results are confirmed with the impedance Audiometry. The patients are classified as Normal, Partial dysfunction and absent function of the Eustachian tube.

The study of ***K.C. Prasad et all*** used the agents such as methylene blue and saccharin for detecting the tubal function in the patients of tympanoplasty. They used the cut off point for the normal ETF as < 10 min and (10 -20 min as the partial impairment of ETF and > 45 min as absent ETF) for the methylene blue to clear out from the middle ear and < 20 min for the saccharin taste in the subjects with normal ETF (10-20 min as the partial impairment and > 20 min as absent ETF)[34].

In our study we are having same time limits for methylene blue dye clearance but for the saccharin taste sensation we consider < 20 min as the normal ETF and 20-40 min as partial impairment of ETF and > 40 min as absent tubal function. Thus the mean time of saccharin taste sensation in our

Study is 20.08 minutes and the mean time for methylene blue dye clearance in our study is 10.2 minutes and hence we are taking 10 minutes as the cut off for the normal ETF, 10-20 minutes is considered as the partial impairment of tubal function and patients with > 20 minutes as the absent ETF.

With the above tests the percentage of patients with the normal functioning Eustachian tube is found to be higher of about 43.75% in the bilateral CSOM and 35.71% with the CSOM of TT type and 23.33% in patients of AA type. Whereas the patients with the partial Eustachian tube function was found to high in the patients of CSOM of TT type about 28.57% which shows the actual pathophysiology of the disease.

The absent ETF is found to be high in the CSOM patients of AA type about 73.33% and it is 43.75% of patients of B/L CSOM and the figure has been further decreased of about 35.71% in patients with CSOM of TT type. The partial impairment of function is present to about3.3% of cases of CSOM of AA type. Thus it indicates that the extensive granulations and the polypoidal changes have attributed to this more number of absent tubal functions in patients of AA type.

According to the ***NICE interventional procedure guidance***[7] the ***pharyngotympanic tubal function*** can be ***improved*** by performing induced

opening of the tube with the ***Valsalva manoeuvres***, drugs such as ***antihistamines, decongestants, topical steroids preoperatively***[40]. Patients who fail to improve with this medical management can be improved by the balloon catheter dilatation at the nasopharyngeal end with the help of endoscope[9].

According to ***Kevin katzenmeyer*** in tympanoplasty the tubal patency is ensured by ***packing with the gelfoam in the middle ear cavity adjacent to the tubal orifice*** to prevent the graft adhesion [41]. The studies done by ***Uzun. C et all*** in comparing the Eustachian tubal function after the cartilage of fascial graft tympanoplasty, the ***hearing results are better with the patients who did the Valsalva exercises preoperatively***[42].

Works of ***J. Fredrick grimmer et all*** also reveals that there is ***no single useful test to study all the tubal functions completely***. They used a combination of tests for the Eustachian tubal function[43].

Thus in our study the patients with the absent tubal function, partial impairment of tubal function and also the patients with the active discharge were prescribed with the antibiotics(oral) according to their culture sensitivity reports and the topical steroid with the antibiotics were advised according to the condition of the middle ear(wet ear with polypoidal changes) in addition to the Valsalva exercises to enhance the tubal function

to the maximum preoperatively, to increase the success rate of the surgery.[32]

According to ***Kevin katzenmeyer et all***, temporalis fascia autograft gives better results compared to other **grafts[41]and** this autograft also eliminates the risk of HIV transmission[44].

The patients in our study group posted for surgery were ensured with the tubal patency by visualizing the Eustachian tubal orifice. ***Any granulations or cholesteatomatous tissue obstructing the tubal orifice were meticulously removed*** and the Eustachian tube was temporarily blocked with the adrenaline soaked gelfoam[45]. This gelfoam was removed before placing the graft. Thus the blockage in the tubal function was intervened intraoperatively for the patients with the partial impairment and absent tubal function [43].

The patients in the postoperative period were given with I.V antibiotics and the Glasscock dressing of the ear was removed after the 3rd post operative period. The suture removal was done after the 7th or 9th post operative period depending upon the condition of the wound [32]. The patients in our study group were advised to come for the regular follow up in the postoperative period once in a week for first 3 weeks. The aural pack was kept to prevent graft lateralization is removed in the 21st postoperative

day. They were reviewed in the next 3 months once in 2-3weeks. The condition of the graft was observed during each visit. The patients were followed up for another 6 months by monthly visits.

The observations of Harikrishnan et all for studying the factors that will improve the outcome of tympanoplasty reveals that there is a good hearing benefit and tympanoplasty results in patients with proper follow up for two years. They also declared that the audiological evaluation of the patient has to be done preoperatively to assess the prognosis and also for the medicolegal point of view [35].

The surgical management of CSOM with dry perforation is not fixed. It varies according to the condition of middle ear mucosa, granulations and ossicular status. Simple mastoidectomy is done in all patients with dry perforation to create an air filled mastoid cavity and to keep the aditus patent, which in turn compensate the disadvantages of absent tubal function. A thorough examination of the entire middle ear pre and postoperatively is a must for all patients planned for surgery.[46]

In our study there is no much difference in success and failure among the age groups (<30 years it is 75.6% and > 30years it is 73.68%). With the above measures we had found that the success rate of patients with the CSOM of AA pathology had improved to 70% and B/L CSOM to 75% and

as like all the studies the success rate of the patients with the patients of tubo tympanic pathology is high about 78.57%.

Thus in our study group , normal ETF of 20 patients , success rate was 95%.,Success rate of patients with the partial impairment of tubal function was 83.33% and the patients with absent ETF was 61.76% . The success rate of CSOM of AA is slightly boosted because of this pre and post operative measures.

The ***pathogens usually enter through the perforation in the tympanic membrane***. Due to ***resistance*** to most of the antibiotics, it becomes ***difficult to treat*** the disease. The complications arise due to spread of infection beyond the middle ear cavity. ***Middle ear suction clearance is the important treatment for all the patients without complication*** [47].

According to shamweel ahmed et all the most commonly affected age group is 21-30 years which remains similar to our study.

The reasons for the bacterial contamination are varied but the common causes what we found in our study group were poor hygiene, overcrowding, and antibiotic abuse. The patient usually goes to the nearby practitioner where the ear drops (without proper aural toileting) and some oral antibiotics were prescribed without doing antimicrobial sensitivity for a short course which leads to drug resistance and the Bioflim formation [48].

The works of A ***Srivastava. et all and Prakash M et all***, reveals ***Staphylococcus aureus is the most common organism followed by Pseudomonas Aeruginosa***[49]. But the studies done by ***Harvinder kumar et all***, shows that ***Pseudomonas aeruginosa*** is more common than staphylococcus aureus which correlates with our study. The results of Harvinder kumar et all**[50]**.

- Plain bacterial infection- 69%
- Plain mycotic infection – 9%
- Mixed infection -6%
- No growth -16%

The patients in our study uses the ear drops whenever she or he has the ear discharge which complicates the scenario resulting in super added Otomycosis.

Regarding the microbiological study in our patients, Pseudomonas aeruginosa is the commonest organism in the patients of CSOM. The figure comes to 15 (ie about 25% of patients got infected with this organisms) of which 9 patients (30% of unsafe pathology patients in our study group) belongs to the CSOM of AA and 6(42% of patients of CSOM of TT

pathology) patients belongs to CSOM of TT type. Thus this organism has more preferences for the tubotympanic than the atticoantral pathology.

Staphylococcus aureus and CONS, were isolated from the 16 patients in our study group. Both these organisms have more preference for the patients with the unsafe pathology (ie) . 6 patients of CSOM of AA has Staphylococcus aureus in the middle ear pus culture sensitivity reports (20% of patients of CSOM of AA) and 2 patients of tubo tympanic pathology shows the same organisms (which means 14.28% of the patients of CSOM of TT pathology).

Likewise the CONS were isolated from 5 patients of CSOM of AA type (16.67% of the patients with the unsafe pathology). CONS were also isolated from 3 patients of CSOM of TT type. This constitutes about 21.42% of patients with safe pathology.

Thus the above bacteriological study in our patients shows that ***staphylococcus aureus and CONS are the emerging organisms*** in our set up. And these organisms are found to be ***resistant to the common antibiotics***.

The ***ciprofloxacin is the most effective antimicrobial agent against Pseudomonas aeruginosa followed by ceftazidime***[51]

SUMMARY

The study conducted in our hospital for a period of two years with an objective to find the role of tubal function in the outcome of tympanoplasty.

- Our study comprises of 60 patients, of which 18 were males and 42 were females. Most of them belong to the lower middle class, living in the rural areas.
- The unsafe pathology is more common with higher incidence of absent tubal function (73.33%).
- The mean age of presentation is 20-29 about 46.67% of our study group.
- The methylene blue dye test and saccharin tests is the simple and cost effective test to assess the mucociliary activity of the tube.
- Preoperative and preoperative measures to retrieve the tubal function add the success rate in patients of tympanoplasty regardless of disease type.
- Proper post operative follow up with the Valsalva exercise is mandatory to maintain the patency of tubal patency.
- Pseudomonas aeruginosa is the most common pathogen isolated from our study group.

CONCLUSION

- Preoperative evaluation of Eustachian tube function is mandatory for all the patients planned for tympanoplasty.
- Preoperative and intraoperative corrective measures should be taken in patients with partial and absent tubal function to improve the success rate.
- Regular postoperative follow up and Valsalva exercises is essential to maintain the patency of Eustachian tube.

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PROFORMA

NAME **AGE/SEX**

ADDRESS **HOSPITAL NUMBER**

CHIEF COMPLAINTS

HISTORY OF PRESENT ILLNESS

- **EAR DISCHARGE** **SIDE**

  Duration

  Nature of discharge

  Intermittent /continuous

  Period of dryness

  Association with URTI

  Recurrent episodes

- **HEARING LOSS** **SIDE**

  Onset **duration**

  Progressive/non progressive

- **EAR PAIN**

Duration **nature**

- **TINNITUS**

Duration **nature**

- **GIDDINESS**

Duration **nature**

NASAL COMPLAINTS

- **OBSTRUCTION**

Duration **unilateral/bilateral**

Seasonal variation

- **NASAL DISCHARGE**

Duration **nature**

- **EPISTAXIS**
- **NASAL ALLERGY**
- **HEAD ACHE**

PAST HISTORY:

- **Exanthematous fever**

1. **Measles**
2. **Rubella**
3. **Typhoid**

4. **Scarlet fever**

- **Trauma**

1. **Accidental**
2. **Surgical**

- **Cleft palate**

PERSONAL HISTORY:

Social status

Overcrowding

Bathing in pond

Malnutrition

TREATMENT HISTORY

GENERAL EXAMINATION

SYSTEMIC EXAMINATION

CVS **RS**

CNS **ABDOMEN**

EXAMINATION OF ENT

- **EAR** **RIGHT** **LEFT**

Preauricular region

Pinna

Post auricular region

External auditory canal

Tympanic membrane

Ossicles

Middle ear mucosa

Attic region

Fistula test

- **TUNING FORK TEST RIGHT LEFT**

Rhinne's test

256HZ

512HZ

1024HZ

Weber's test

512HZ

ABC test

- **TEST FOR EUSTACHIAN TUBE FUNCTION**
  - **Time taken for saccharin clearance**
  - **Time taken for methylene blue clearance**
  - **Diagnostic nasal endoscopy**
  - **Valsalva test**
  - **Impedance Audiometry**

NOSE AND PARANASAL SINUSES

  - **Anterior Rhinoscopy**
  - **Posterior Rhinoscopy**

- **ORAL CAVITY AND THROAT**

INVESTGATIONS:

- **Routine blood examination**
- **Bleeding time and clotting time**
- **Urine routine**
- **Pus culture and sensitivity**

  -bacteria

  -fungus

- **CT-mastoid**
- **X ray PNS**
- **Pre operative PTA, impedance Audiometry**

DETAILS OF SURGERY

- **Date**
- **Type of surgery**
- **Follow up**
  - **1st**
  - **2nd**
  - **3rd**
- **Condition of the graft**
  - **Intact**
  - **Rejected**
- **Condition of the ear**
  - **Dry**
  - **Active**
  - **Granulomatous**

POST OPERATIVE:

PTA

TYMPANOMETRY

ABBsREVIATIONS

- **CSOM -- CHRONIC SUPPURATIVE OTITIS MEDIA.**
- **TT -- TUBO TYMPANIC.**
- **AA -- ATTICO ANTRAL.**
- **ET -- EUSTACHIAN TUBE.**
- **MT -- MIDDLE TURBINATE.**
- **ITH -- INFERIOR TURBINATE HYPERTROPHY.**
- **MTH -- MIDDLE TURBINATE HYPERTROPHY.**
- **UP -- UNCINATE PROCESS.**
- **OMC -- OSTEO MEATAL COMPLEX.**
- **DNE -- DIAGNOSTIC NASAL ENDOSCOPY.**
- **DNS -- DEVIATED NASAL SEPTUM.**
- **CT -- COMPUTERISED TOMOGRAM.**
- **CHL -- CONDUCTIVE HEARING LOSS.**
- **HL -- HEARING LOSS.**
- **SNHL -- SENSORY NEURAL HEARING LOSS.**
- **L -- LEFT SIDE.**
- **R -- RIGHT SIDE.**
- **MRM -- MODIFIED RADICAL MASTOIDECTOMY.**
- **TYMP -- TYMPANOPLASTY**
- **PNS -- PARA NASAL SINUS.**

- **SMR -- SUB MUCOSAL RESECTION.**
- **FESS -- FUNCTIONAL ENDOSCOPIC SINUS SURGERY**.
- **HSD -- HIGH SEPTAL DEVIATION.**
- **HPT -- HYPERTROPHY.**
- **TVPM -- TENSOR VELI PALATINI MUSCLE.**
- **LVPM -- LEVATOR VELI PALATINI MUSCLE.**
- **CP -- CEREBELLOPONTINE.**
- **AOM -- ACUTE OTITIS MEDIA.**
- **OME -- OTITIS MEDIA WITH EFFUSION.**
- **BC -- BEFORE CHRIST.**
- **B/L -- BILATERAL.**
- **ETF -- EUSTACHIAN TUBE FUNCTION.**
- **CONS -- COAGULASE NEGATIVE STAPHYLOCOCCUS AUREUS.**
- **SPP -- SPECIES.**
- **MIN -- MINIMAL.**
- **MOD -- MODERATE.**
- **SEV – SEVERE.**
- **TEMP FASCIA—TEMPORALIS FASCIA.**
- **IMP - IMPEDANCE**

S.No	PatientDetails	Age/ Sex	Diagnosis	Measure taken to retrieve	Bacteriology	Pre op etf	Pre op DNE	Pre op PTA & Imp	Surgery Done	Ossiculoplasty	1st Follow	2nd Follow	3rd Follow	
1	Bhuvaneshwari, Thirumanur, Ariyalor-DT	30/F	B/L CSOM(AA)	Taken	Pseudomonas	Absent	Normal Study	R-Ear 48dB ModCHL L-Ear 61dB Mod-sev HL	L-MRM with type III tympanoplasty	Homologous Septal spur cartilage	Graft in situ	Graft Healthy	Graft Taken up well	
2	Priya, Mannarkudi, Thiruvarur-dt.	23/F	L CSOM(AA)	Taken	Pseudomonas	Absent	Normal Study	Both Ear 20dB MinHL	L-MRM with type III tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Taken up well	
3	Robert Michael, Thirugadupalli, Thanjavur-dt.	37/M	L CSOM(AA)	Taken	Staph aureus	Absent	Normal Study	R-Ear 75dB Sev Mixed HL L-58dB Mod-SevHL	L-MRM with type III tymp	Homologous Septal spur cartilage	Graft in situ	Graft Healthy	Graft Taken up well	
4	Tamil Mani, Karukadipatti,Orathanadu,Thanjavur-dt.	33/F	L CSOM(TT)	Taken	No Growth	Present(partial dysfunction)	Normal Study	R -Ear18dB Normal Hearing, L-Ear25dB Min CHL	L - Endoscopic Myringoplasty with Middle ear exploration	---	Graft in situ	Graft Healthy	Graft Taken up well	
5	Jayalakshmi, Karanthai, Thanjavur.	27/F	L CSOM(TT)	Taken	No Growth	Present(partial dysfunction)	Normal Study	R -Ear15dB Normal Hearing, L-Ear31dB Min CHL	L-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Healthy	Graft Taken up well	
6	Jayalakshmi, Athanakottai, Pudukottai-dt.	24/F	R CSOM(AA)	Not Taken	Pseudomonas	Absent	R-DNS& OMC Crowding +	R -Ear Total Hearing Loss , L-Ear23dB Min CHL	L-MRM with type III tymp & facial nerve decompression	Homologous Septal spur cartilage	Graft in situ	Graft Healthy	Graft Taken up well	
7	Ravichandran, Pattukottai, Thanjavur-dt.	31/M	R-CSOM(TT)	Not Taken	Strep Pneumoniae	Absent	Adenoid HPT + L HSD+ OMC Crowding +	R -Ear40dB Mod CHL, L-Ear25dB Min CHL	R-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Perforated	Graft Perforated	
8	Anuratha, Thanjavur	35/F	L CSOM(AA)	Taken	Citrobacter Spp	Absent	Normal Study	R -Ear38dB Min CHL, L-Ear56dB Mod - Sev CHL	L-Simple Mastoidectomy with type I tymp	Autologus Malleus Graft	Graft in situ	Graft Perforated	Graft Perforated	
9	Balamurugan, Papanasam, Thanjavur-dt.	26/M	R CSOM(AA)	Taken	No Growth	Absent	B/L Sup Tub Sec+, B/L HSD+ ,BullousMT+, B/L Med Unc+	R -Ear33dB Min CHL, L-Ear96dB Sev CHL	L-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Perforated	Graft Perforated	
10	Ravichandran, Akkur Nagai-dt.	37/F	R CSOM(AA)	Taken	No Growth	Absent	B/L HSD+, DNS - L	R -Ear56dB Mod CHL, L-Ear20dB Normal	R-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Perforated	Graft Perforated	
11	Manjula, Thanjavur	28/F	R CSOM(TT)	Taken	No Growth	Absent	Normal Study	R -Ear76dB Sev- Mixed HL, L-Ear28dB Min CHL	R-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Perforated	Graft Perforated	

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12	Ramalingam, Thanjavur	49/M	B/L CSOM(TT)	Taken	MRSA	Present& normal	B/L HSD+, Bullous MT+	R -Ear31MIN CHL, L-Ear40dB Min CHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
13	Rekha, Poiundarkottai, Orathanadu, Thanjavur-dt.	35/F	B/L CSOM(TT)	Taken	Pseudomonas	Present& normal	B/L HSD+, DNS - L	R -Ear51dB Mod CHL, L-Ear41dB Normal	L-MRM with type III tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Taken up well	
14	Kavitha, Thanjavur	35/F	L CSOM(AA)	Taken	No Growth	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear41dB ModCHL	L-Atticotomy	Scutum Reconsituti on with folded temp. Fas	Graft in situ	Graft Healthy	Graft Taken up well	
15	Hemalatha, Orathanadu Thanjavur	30/F	L CSOM(TT)	Taken	No Growth	Absent	Normal Study	R -Ear26dB Min CHL, L-Ear28dB Min CHL	L-Simple Mastoidectomy with type I tymp	---	Graft in situ	Graft Perforated	Graft Perforated	
16	Parameswari, Paravurani, Thanjavur-dt.	20/F	R CSOM(AA)	Taken	Coag Neg Staph aureus	Present& normal	B/L HSD+	R -Ear55dB Mod CHL, L-Ear28dB Min CHL	R-MRM with type III tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Taken up well	
17	Rathika Ariyalur.	23/F	L CSOM(AA)	Taken	No Growth	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear36dB ModCHL	L-MRM with type III tymp	Homologou s Septal spur cartilage	Graft in situ	Graft Healthy	Graft Taken up well	
18	Shanmugasundram, Thiruvidaimarudur, Thanjavur-dt.	47/M	L CSOM(AA)	Taken	No Growth	Present& normal	DNS - L	R -Ear26dB Min CHL, L-Ear46dB Mod CHL	L-MRM with type III tymp	Autologous Malleus Graft	Graft in situ	Graft Healthy	Graft Taken up well	
19	Chitra, thanjavur	29/F	R CSOM(TT)	taken	No Growth	Present(partial dysfunction)	Normal Study	R- ear mod CHL,L-Ear normal hearing	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
20	Ananthi, kattur, ariyalur dt	27/F	R CSOM(TT)	taken	No Growth	Absent	Normal Study	R- ear mod CHL,L-Ear normal hearing	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
21	Muneeshvaran, thanjavur	21/M	L CSOM(TT)	taken	No Growth	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear33dB ModCHL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
22	Muthamilselvi, thiruvaiyaru	33/F	L CSOM(AA)	taken	klebsiella spp isolated	Absent	B/L ITH +	R -Ear Normal Hearing , L-Ear38dB ModCHL	L-Simple Mastoidectomy with type III tymp	Autologous Malleus Graft	Graft in situ	Graft Healthy	Graft Taken up well	
23	Parameswari , alakudi, Thanjavur-dt.	18/F	L CSOM(AA)	taken	Coag Neg Staph aureus	Present& normal	B/L HSD+	R Ear 46dB mod CHL,L Ear 41 Db	L-MRM with type II tymp		Graft in situ	Graft Healthy	Graft Taken up well	
24	Sundari, sathamangalam, ariyalur dt	25/F	L CSOM(AA)	taken	No Growth	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear30dB MinCHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
25	Maheswari, pattukottai ,thanjavur dt	22/F	L CSOM(AA)	taken	Pseudomonas	Absent	DNS - L, septal buckling R side	R -Ear20dB Min CHL, L-Ear38dB Min CHL	L-MRM with type III tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Taken up well	

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26	Indiragandhi, thirumanoor	50/F	B/L CSOM(TT)	taken	Pseudomonas	Present& normal	DNS - R side	R -Ear53dB Mod CHL, L-Ear63dB mod -seve CHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
27	Mahalakshmi, gandarvakottai	20/F	R CSOM(TT)	taken	No Growth	Present& normal	DNS - L, septal buckling R side	R -Ear21dB MinCHL , L-Ear Normal Hearing L	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Taken up well	
28	Maheswari, pattukottai ,thanjavur dt	22/F	B/L CSOM(TT)	taken	Pseudomonas	Present& normal	DNS - L, septal buckling R side	R -Ear33dB Min CHL, L-Ear28dB Min CHL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
29	Parthiban, thiruvedhikudi	25/M	R CSOM(AA)	taken	Staph aureus	Absent	Normal Study	R -Ear21dB MinCHL , L-Ear Normal Hearing L	R-MRM with type III tymp	Autologous Malleus Graft	Graft in situ	Graft Perforated	Graft Perforated	
30	Praveen, Orathanadu Post, Thanjavur dt	18/M	R CSOM(AA)	taken	Coag Neg Staph aureus	Absent	Normal Study	R -Ear43dB MinCHL , L-Ear Normal Hearing L	R-MRM with type III tymp	reshapened grommet	Graft in situ	Graft Healthy	Graft Healthy	
31	Vithyashree, thanjavur	24/F	L CSOM(AA) with facial nerve palsy	taken	Pseudomonas	Absent	Normal Study	R -Ear Normal Hearing , L-Ear46dB ModCHL	L-MRM with type III tymp & facial nerve decompression	autologous conchal cartilage graft	Graft in situ	Graft Healthy	Graft Healthy	
32	Prakash, thanjavur	17/M	R CSOM(AA)	taken	No Growth	Absent	Normal Study	R -Ear30dB MinCHL , L-Ear Normal Hearing L	R-MRM with type III tymp	Autologous Malleus Graft and attic defect with the reshapened incus	Graft in situ	Graft Healthy	Graft Healthy	
33	Selvakumar	18/M	L CSOM(AA)	taken	No Growth	Absent	adenoid HPT +,B/L HSD+ ,B/LOMC Crowding +	R -Ear Normal Hearing , L-Ear36dB ModCHL	L-MRM with type III tymp	autologous stapes graft &attic reconstruction with the reshapened incus	Graft in situ	Graft Healthy	Graft Healthy	
34	Raja	35/M	L CSOM(TT)	taken	Coag Neg Staph aureus	Absent	B/L accessory ostium+, R Bullous MT+	R -Ear26dB MinCHL , L-38dB min CHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
35	Shenbagavalli, thanjavur	65/F	B/L CSOM(TT)	taken	No Growth	Present(partial dysfunction)	submucosal cleft palate present	Both theEar Mixed HL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	

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36	Shanthi,cholapuram, orathanadu	26/F	B/L CSOM(TT)	taken	No Growth	Present& normal	R, HSD+,R, Bullous MT+	R -Ear Normal Hearing , L-Ear18dB Min CHL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Perforated	
37	Vigneshwaran, aranthangi, puthukottai dt	22/M	L CSOM(TT)	taken	Staph aureus	Present& normal	adenoid HPT +,B/ L HSD+ ,B/LOMC Crowding +	R -Ear Normal Hearing , L-Ear36dB ModCHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
38	Kavitha, Thanjavur	30/F	B/L CSOM(TT)	taken	No Growth	Absent	Normal Study	R -Ear63dB Mod -Severe CHL, L-Ear63dB mod - seve CHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Perforated	Graft Perforated	
39	Vasanthi,thanjavur	36/F	B/L CSOM(TT)	taken	No Growth	Present& normal	Normal Study	R -Ear28dB MinCHL , L-18dB min CHL	R Sided endoscopic myringoplasty		Graft in situ	Graft Healthy	Graft Healthy	
40	Suganya, thanjavur	15/F	B/L CSOM(TT)	taken	klebsiella spp isolated	Present(partial dysfunction)	DNS - L, septal buckling R side, septal spur L side	R Ear 38dB mod CHL,L Ear 45dB	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
41	Akash, kulathur, pithukottai	15/M	L CSOM(AA)	taken	Staph aureus	Absent	adenoid HPT +,B/ L HSD+ ,R-OMC Crowding +	R -Ear Normal Hearing , L-Ear51dB ModCHL	L-MRM with type III tymp	Autologous Incus Graft & Aditus reconstruction with septal cartilage	Graft in situ	Graft Healthy	Graft Healthy	
42	Kumaresan, panchathottakurichi, karur dt	24/M	L CSOM(TT)	taken	No Growth	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear33dB MinCHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
43	Thangapalani, karambakudi, puthukottai dt.	18/M	B/L CSOM(TT)	taken	Coag Neg Staph aureus	Absent	Normal Study	R Ear 33dB min CHL,L Ear 53dB mod severe mixed hearing loss	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
44	Nagarajan, madirampatti, puthukottai dt	29/M	B/L CSOM- R side AA type, L sude TT TYPE	taken	Enterococcus grown in the culture	Absent	Normal Study	R -Ear66dB Mod -Seve mixed HL, L-Ear 51dB mod mixed HL	R-MRM with type III tymp	Homologous Septal spur cartilage	Graft in situ	Graft Healthy	Graft Healthy	
45	Renganayaki,ammapettai	23/F	L CSOM(AA)	taken	Coag Neg Staph aureus	Absent	adenoid HPT +,B/ L HSD+ ,B/LOMC Crowding +	R -Ear25dB MinCHL , L-50dB mod CHL	L-MRM with type III tymp	Homologous Septal spur cartilage	Graft in situ	Graft Healthy	Graft Healthy	

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46	Ramya, thanjavur	19/F	B/L CSOM(TT)	taken	Pseudomonas	Present& normal	L - HSD+& Bullous MT+, B/L OMC crowding	R -Ear35dB CHL , L-38dB CHL	L-Simple Mastoidectomy with type I tymp with B/L Conchoplasty		Graft in situ	Graft Healthy	Graft Healthy	
47	Rajkumar, thanjavur	17/M	L CSOM(AA)	Not Taken	Pseudomonas	Absent	Normal Study	R -Ear Normal Hearing , L-Ear33dB MinCHL	L-MRM with type III tymp	Homologous Septal spur cartilage	Graft in situ	Graft Perforated	Graft Perforated	
48	Selvam, thanjavur	28/M	R Reccurrent CSOM	Not Taken	Pseudomonas	Absent	Normal Study	R -Ear33dB MinCHL , L-16dB Normal haering	R Revision mastoidectony		Graft in situ	Graft Perforated	Graft Perforated	
49	Sharmila, thirupurampiyam	18/F	L CSOM(TT)	taken	Staph aureus	Present& normal	Normal Study	R -Ear Normal Hearing , L-Ear33dB Min CHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
50	Shilfana begam, thanjavur	18/F	L CSOM(AA)	taken	Staph aureus	Absent	R septal spur+ ,B/ L HSD+ ,B/LOMC Crowding +	R -Ear Normal Hearing , L-Ear51dB Mod CHL	L-MRM with type III tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Healthy	
51	Mallika, thanjavur	40/F	B/L CSOM(TT)	taken	Pseudomonas	Absent	Normal Study	R -Ear68dB mixed HL, L-Ear 56dB mixed HL	R-MRM with type III tymp		Graft in situ	Graft Healthy	Graft Healthy	
52	Hariprasad, Karanthai, thanjavur.	27/Me	L CSOM(AA)	taken	Staph aureus	Absent	adenoid HPT +,B/ L HSD+ ,B/L Accessory ostium+	R -Ear Normal Hearing , L-Ear28dB MinCHL	L-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
53	Kanimozhi, orathanaadu, thanjavur.	16/F	L CSOM(AA)	taken	Staph aureus	Absent	B/ L HSD+ ,L Accessory ostium+	R -Ear18 Normal Hearing , L-Ear28dB MinCHL	L- Transcanal atticotomy & myringoplasty		Graft in situ	Graft Perforated	Graft Perforated	
54	Nawab sulthan, Municipal colony, thanjavur.	28/M	R CSOM(AA) with subperiosteal abscess	Not Taken	Pseudomonas	Absent	Normal Study	R -Ear68dBmod-severe CHL, L-Ear normal hearing	R-MRM done		Graft in situ	Graft Perforated	Graft Perforated	
55	Kalaiyarasi, naducauvery, thanjavur.	24/F	L CSOM(AA)	taken	Coag Neg Staph aureus	Present(partial dysfunction)	Normal Study	R -Ear33dB MinCHL , L-Ear Normal Hearing	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Perforated	
56	Uma, Vallam, thanjavur.	30/F	R CSOM(AA)	taken	No Growth	Present& normal	Normal Study	R -Ear40dB MinCHL , L-Ear20 Normal Hearing	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
57	Lakshmanan, Senthalai,kandiyur po, thanjavur	20/M	R CSOM(AA)	taken	Pseudomonas	Absent	Normal Study	R -Ear36dB MinCHL , L-Ear20 Normal Hearing	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	
58	Saranya, budhalur, thanjavur	17/F	B/L CSOM(TT)	taken	Pseudomonas	Absent	Normal Study	R -Ear70dB mod- mixed HL, L-Ear 61dBmod-mixed HL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Perforated	

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59	Kumaresan, thanjavur	20/M	B/L CSOM(TT)	taken	Pseudomonas	Absent	Normal Study	R -Ear33dB MinCHL , L-Ear 43db mod CHL	L-MRM with type I tymp	Autologous Incus Graft	Graft in situ	Graft Healthy	Graft Perforated	
60	Ravichandran, pattukottai,thanjavur	21/M	R CSOM(TT)	taken	Coag Neg Staph aureus	Present(partial dysfunction)	Normal Study	R -Ear41dB Mod CHL , L-Ear36 mild CHL	R-Simple Mastoidectomy with type I tymp		Graft in situ	Graft Healthy	Graft Healthy	